Appendix K

Noise Study

NOISE MONITORING AND PREDICTIVE MODELING TECHNICAL REPORT

WESTERN GREENBRIER CO-PRODUCTION DEMONSTRATION PROJECT

GREENBRIER COUNTY, WEST VIRGINIA

May 26, 2006

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1. EXECUTIVE SUMMARY

Western Greenbrier Co-Gen, LLC (WGC) is proposing to design, construct, and operate a 92 megawatt net electric output (MWe) atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 2,700 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County. This noise report has been prepared for the WGC project in order to provide information needed to assess the potential for impacts of the proposed facility on the local community from a noise perspective.

This report includes information on baseline noise data for the project area, as well as results of predictive modeling conducted using standard techniques for predicting noise from transportation and industrial sources. The noise analyses that is the basis for this report includes monitored noise levels for the 2004 Existing Conditions and predicted noise levels for the 2008 No Build and Build conditions (i.e., construction and operation of the facility). The primary noise sources, which may increase ambient noise levels in the community that are associated with the proposed project, include:

- Mobile sources – additional truck and auto traffic to and from the site due to employees and transport of materials, and
- Stationary sources – equipment operating at the plant site.

To evaluate the potential for significant noise-related impacts from the power plant, an upper limit criterion at the boundaries of the plant site was established. In the absence of applicable local requirements, an L_{dn} of 60 dBA was selected to be the upper limit threshold. An L_{dn} of 60 dBA would be equivalent to a continuous noise level of 53.6 dBA. An increase of baseline noise levels greater than 10 dBA was used to assess the potential for significant impacts on transportation corridors. A 10 dBA increase was selected because it represents a perceived doubling of noise level and the maximum threshold for a significant increase used by state departments of transportation. This report does not assess the noise exposure for workers at the cogeneration plant, quarries, or coal refuse sites because this exposure is controlled under workplace regulations established by the Occupational Safety and Health Administration (OSHA). Blasting is addressed qualitatively. Although blasting activities are anticipated during site preparation, the details of the blasting plans are not yet available, so predictive modeling cannot be carried out.

Noise monitoring was conducted to establish baseline conditions for assessing both transportation and facility operation impacts. Transportation-related monitoring was conducted to be coincident with peak traffic hours and other representative time frames as is typical for transportation-related projects. These measurements were typically collected using 15-minute intervals with corresponding traffic counts. Long-term (24 hour) noise monitoring was conducted based on consultation with the West Virginia Public Services Commission to characterize areas adjacent to the proposed facility. The day-night noise levels (L_{dn}s) were then estimated or calculated for these areas based on the monitored values.

Predictive noise modeling for transportation-related noise impacts was completed using the FHWA's traffic noise model (TNM). Baseline noise data that was collected was used to calibrate the model. Predictive noise modeling for noise generated by the operation of the proposed facility was completed using the Computer Aided Noise Abatement (CADNA 3.4) Model which was specifically developed for modeling power plant and other industrial facility noise. Outputs from both models are based on design and operational related information that was available at the time the modeling was completed, and is subject to change as design and operational plans for the facility evolves.

Predictive modeling outputs indicate that traffic noise during the peak AM, Midday, and PM periods at locations along the proposed transportation corridors in Rainelle, Rupert, Charmco, Green Valley, Quinwood, Anjean, and Hillsboro would fall below the identified impact increment of 10 dBA. Most of the predicted increases are below a 5 dBA increase. The exceptions are a maximum predicted increase of 6.3 dBA on Anjean Road, and 5.7 along the road between the Anjean and Donegan coal refuse areas. No truck traffic is anticipated during nighttime periods between the sources of materials and the power plant.

Without noise controls for significant noise sources incorporated into the power plant design (base plant), noise levels at the site boundary and residences in the vicinity of the site would exceed an L_{dn} of 60 dBA. Base plant modeling results indicate that resulting L_{dn}s at monitored sites would range from 61.5 to 71.3 dBA. This modeling was based on an earlier site plan configuration that represents a worse case than the current site plan. The base plant modeling does not include the full range of available noise attenuation and mitigation measures that may be incorporated in the plant design, as detailed specifications and equipment vendors on which these measures are dependent have not yet been finalized.

Based on the noise level increases predicted for the “base plant,” it is expected that the incorporation of reasonably available mitigation measures can reduce the noise levels at the site’s property line to 60 L_{dn} or less. To achieve the 60 L_{dn} noise target at the sensitive sites, mitigation would need to incorporated into the facility design to reduce noise levels of key noise contributors to below 53.6 dBA (more specifically to approximately 20.0 to 40.0 dBA). It is expected that this objective could readily be accomplished with available methods such as fan silencers, acoustic enclosures, absorptive material on interior walls, acoustic ducts and louvers, fan deck barriers, air inlet barriers, and more robust structural materials. Based on the results of the predictive modeling, it is expected that WGC will need to ensure that contractors and vendors are contractually obligated to provide equipment that will meet the specified noise levels at the plant’s property lines.

Construction noise and blasting were addressed in a qualitative manner as more detail on the phasing and equipment is needed to prepare a more detailed analysis. Potential mitigation measures for construction noise and blasting are outlined.

2. PROJECT OVERVIEW

2.1 INTRODUCTION

This noise technical study has been prepared for the Western Greenbrier Co-Generation (WGC) project in order to provide information to assess the proposed facility's potential to cause noise impacts on the local community. It includes basic information on noise principles, baseline noise data for the project area, and results of predictive modeling using standard techniques for predicting noise from industrial sources. This technical study has been prepared by Potomac-Hudson Engineering, Inc. (PHE) under contract to the US Department of Energy as part of the efforts to prepare an Environmental Impact Statement (EIS) to assess overall project impacts. The configuration of buildings and activities evaluated for this report are based on the August 2005 site plan, which constitutes a "worst-case" for determining potential impacts. Thus, future design changes may not require further analysis if they reduce the potential for noise impacts.

2.2 WESTERN GREENBRIER CO-GEN PROJECT

WGC is proposing to design, construct, and operate a 92 megawatt net electric output (MWe) atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 2,700 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County. The confluence of Sewell Creek and the Meadow River is roughly 1.5 miles northeast of the proposed plant site. A coal-fired rotary kiln associated with the power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks. Currently, plans show the ash byproduct manufacturing plant located on the north side of Sewell Creek adjacent to the Eco Park. The power plant would serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heat and other industrial activities. Without the power plant, the Eco-Park may not be developed.

Waste coal (coal refuse) initially would be obtained from abandoned waste coal piles located on CR 1 on Anjean Mountain. Both the Anjean coal mine and the Donegan mine further north on CR 1 in Nicholas County are anticipated sources of coal refuse (see Figure 2-1).

Excess combustion ash not needed for manufacturing the ash byproduct would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal pile sites for obtaining a fuel source when the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, potential future waste coal pile sites would be within 20 to 30 miles of the power plant site. The most likely candidate to be used as a second source of fuel by WGC is the Green Valley Site, located north of Quinwood on Route 20. The Green Valley site is adjacent to an active coal mine, and the site is highly disturbed from mining activities. In its current state, the site consists of waste-coal piles that were placed on steep ridges, contoured, and covered with planted pines.

Both rail and truck were initially considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal. However, considerations for rail transport by WGC were abandoned due to economic considerations and the associated feedback received from the local community.

The fuel extraction and transportation methods would be the same for both waste coal sources. Mobile equipment would scrape waste fuel material from a pile or deposit and dump it into a 3-axle, 40-ton truck. These trucks would transport coal refuse and pond fines from Anjean Mountain and/or Green Valley to nearby beneficiation plants, where the coal refuse material would be crushed and screened, while the pond fines would be deslimed, dewatered, and separated into low-ash and high-ash cakes. .

Limestone from a local quarry, most likely the Alta Quarry in the Lewisburg area, would be transported to the WGC facility in 20-ton trucks, stored in an enclosed building, and subjected to primary and secondary crushing. The limestone is used in firing the boiler, in a scrubber to reduce the plant's air pollutant emissions, and in the manufacture of ash byproduct. An alternative source for the Limestone is the Mill Point Quarry on WV 219 in Hillsboro, in Pocahontas County.

At the WGC site, low-ash cakes and crushed coal refuse would be mixed with limestone and a higher quality of coal and burned as fuel in the cogeneration plant's boiler. High-ash cakes from the pond fines would be mixed with boiler ash for return by truck to the waste pile of origin (Anjean or Green Valley), where it would be used to remediate acid drainage from the waste coal piles.

Fly ash resulting from the plant's combustion of coal refuse and pond fines would be mixed with limestone and baked in a coal-fired rotary kiln to create a cementitious ash byproduct. Additional materials transported to the site for the kiln operation include alumina, gypsum, and other additives. The cementitious product would be mixed with wood chips from waste wood sources to manufacture a molded building block that can be used for building construction and insulation. This plant is one of the anticipated tenants in the Eco Park. Although the kiln for this plant would be operated 24 hours per day, at a location near the power plant, the manufacturing of the ash byproduct would occur in the Eco Park area during a typical day shift. Other ventures may find the Eco Park a desirable location at some future point. They could include such operations as an aquaculture fishery or a hydroponic greenhouse.

2.2 SITE DESCRIPTION

The WGC plant would be located on an 89-acre site on the south side of Rainelle near the intersection of U.S. Route 60 and State Route 20. Route 20 and the CSX rail tracks lie to the west and north of the site, a residential neighborhood borders the site to the east, and a mountain ridge borders the site to the south. Sewell Creek and its associated floodway run through the site on an east-west alignment, dividing the site into two major sections. Approximately 20 acres lie north of the creek. A portion of this area is occupied by the existing Rainelle Industrial Park (the "Eco Park"). Further development of this area would occur, as part of an Eco Park concept, by industries using steam and other byproducts from the power plant.

Approximately 69 acres of contiguous tracts lie south of the creek, including portions of a mountain ridge. Approximately half of this southern area (34 acres) would be developed for the power plant. The ridge is approximately 2,200 feet southeast of the intersection of US 60 and WV 20. It varies from an elevation of approximately 2,395 feet at the base to 2,535 at its highest point. Portions of the ridge would be excavated for the plant, resulting in a base elevation of 2,416 feet for the cogeneration facilities. A plateau 20 feet above the floodplain (i.e., an elevation of 2,420 feet with the floodplain at 2,400 feet) will be formed for a power island and ash processing equipment associated with the cogeneration plant. Materials handling for the power plant would occur on the south side of the power plant site. This includes truck loading and unloading, and trucks idling. Conveyor belts would transport materials from the delivery area on the southwest portion of the site to various buildings in the central portion of the site..

Tom Raine Drive currently provides access to the developed portion of the industrial park from Route 20. The West Virginia Department of Transportation intends to extend Tom Raine Drive, including a bridge spanning the Sewell Creek floodway, to provide access to the south section of the site. Figure 2-1 shows the site location, and Figure 2-2 shows the layout of the site in relation to the surrounding area.

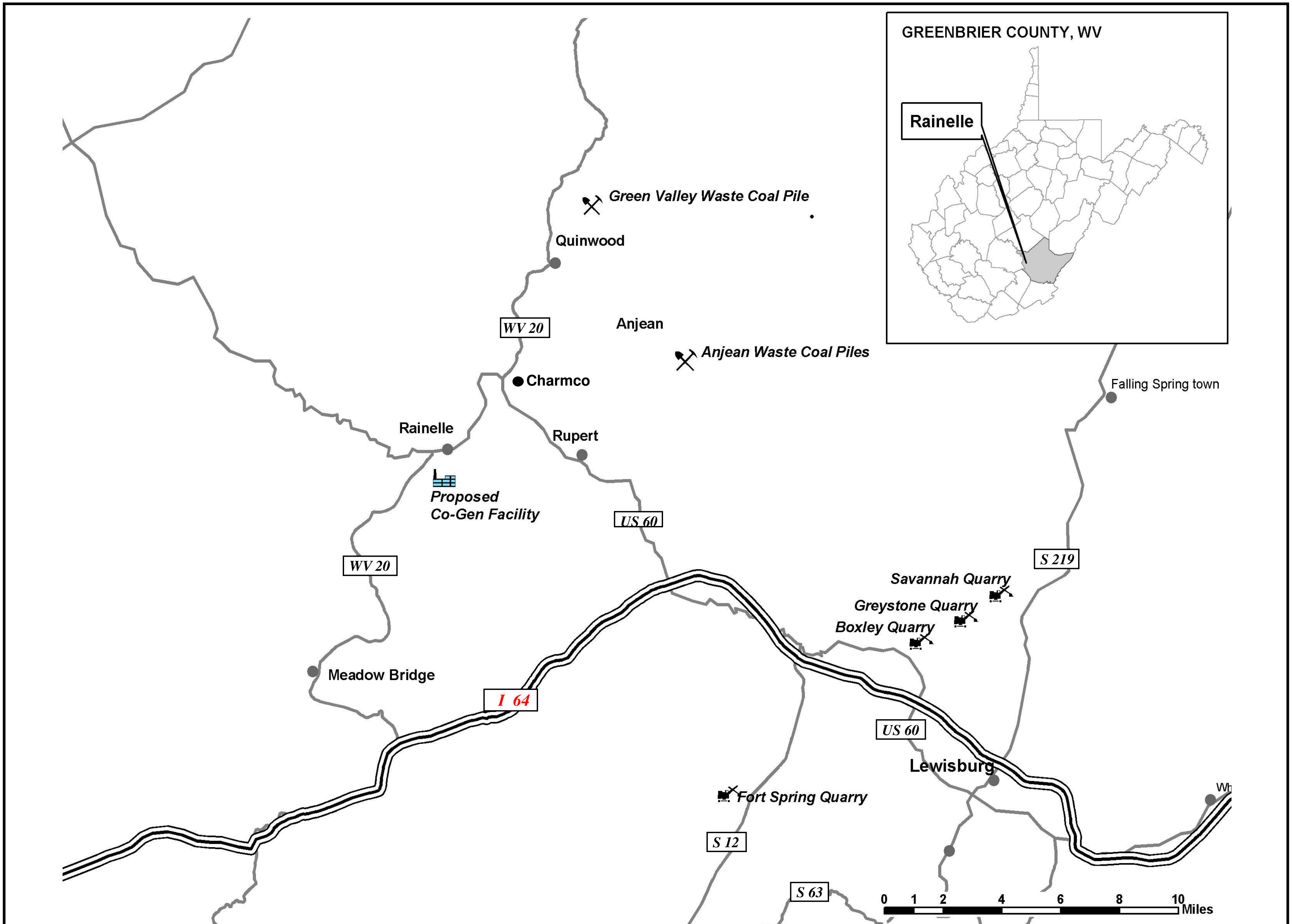

Figure 2-1
WGC General Project Location Map

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Figure 2-2
WGC Power Plant Site Layout (Rainelle, WV)

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2.3 SCOPE OF STUDY

The scope of this study included the collection of baseline noise data for the project area, as well as conducting predictive modeling using standard techniques for roadway and industrial sources. The primary project-generated noise sources that may increase ambient noise levels in Rainelle and the transportation corridors are:

- Mobile Sources – additional truck and auto traffic to and from the site due to employees and transport of materials, and
- Stationary Sources – equipment operating at the plant site.

Potential impacts from these sources were assessed for the plant's property line and sensitive receptor points such as schools, parks, and residences in the vicinity of the roadways and plant site. Only noise sources associated with the project that were expected to substantially contribute to noise levels were considered in this analysis. Worker exposures to high noise levels at the cogeneration plant, quarries, or coal refuse areas are not included in this analysis because they are covered under workplace regulations established by OSHA and are beyond the scope and purpose of this report. Construction noise, especially blasting, is addressed because blasting activities are anticipated for site preparation. Freight rail noise is not included in this technical report because freight trains pass through Rainelle once or twice per day, without a fixed schedule, and they currently are not a proposed transportation mode for the coal refuse or manufactured products. Although the ash byproduct manufacturing plant is an integral part of the project concept, other potential tenants may not occupy the Eco Park until after the 2008 Build year. Because the sizes and traffic generation characteristics of other Eco Park tenants are speculative at this time, these potential sources were not included in the analysis of impacts for the cogeneration plant. Only traffic for the power plant and ash byproduct facility are included this study.

To evaluate the potential noise impacts, a noise monitoring program was carried out to establish existing noise levels along transport roadways, as well as at locations near the plant site. This information also was used to calibrate industry standard models and methods subsequently used to determine existing and future noise levels based on worst-case projections of traffic volumes and plant noise. Increases in trucks and autos along traffic corridors were analyzed using the FHWA's Traffic Noise Model (TNM) 2.5. Noise from the plant's proposed operating equipment was analyzed using CADNA, a software model designed for analyzing industrial noise.

2.4 NOISE STUDY AREA

The noise study area includes locations in Rainelle as well as communities along the transportation corridors to the coal refuse piles or limestone quarries. The study area was defined based on professional judgment and consultation with the West Virginia Public Services Commission. Two study areas, described below, have been defined according to the project-generated noise source: either traffic or the power plant. Some sensitive receptor points in Rainelle may fall into both noise study areas.

2.4.1 Traffic Noise

Motor vehicle traffic through Rainelle, Charmco, Rupert, Quinwood, Green Valley, and Anjean would increase because trucks would transport coal, coal refuse, limestone, and waste wood to the site. Additional Trucks would pass by on CR1 north of Anjean if the Donegan quarry is used as a coal refuse source. If the Mill Point Quarry becomes a source of limestone, then communities along CR 219 between CR 60 and CR 39 in Hillsboro would also experience increased truck traffic. Trucks also would transport the commercial ash byproduct to markets outside of Rainelle; these trucks are expected to travel east to

Interstate 64. Additional traffic also would occur due to employee vehicles traveling to and from the site. Employees at the cogeneration plant and the kiln for the ash byproduct would work primarily in one 8-hour daytime shift, although some employees would provide minimal staffing during the remaining 16 hours. Employees at the ash byproduct manufacturing plant, the administrative office, and other buildings, are expected to work the daytime shift.

Therefore, the relevant study area related to potential noise impacts from traffic generated by the project includes sensitive receptors on:

- Route 1 between Donegan Quarry on Anjean Mountain and Route 60 in Rupert,
- Route 60 from the intersection with Route 1 in Rupert to the intersection with Route 20 in Charmco,
- Route 20 between Green Valley and Route 60 in Charmco, and
- Route 20/60 from Charmco through Rainelle.
- Route 219 between Route 60 in Lewisburg and CR 39 in Hillsboro.

2.4.2 Power Plant Noise

The cogeneration plant includes the operation of heavy industrial equipment that would represent a new noise source in the area local to the proposed site. Detailed information on the specific equipment and operations that relate to noise levels is provided in the section on Build Conditions. Sensitive receptors that could be affected by noise from the proposed cogeneration plant include homes that currently experience low levels of noise due to their distance from highways and rail tracks. A radius of 1,000 feet from the plant site was used to define the study area for noise from the plant operations. Locations beyond this distance would be influenced more by local traffic noise than by plant noise. Within the 1,000-foot study radius, the primary focus is on noise levels at the site boundaries and at nearby homes. Therefore, the study area does not have to encompass a larger radius in order to identify potential impacts if noise levels at nearby sensitive receptors are below the impact criteria.

3. NOISE PRINCIPLES

3.1 INTRODUCTION

Noise is defined as any unwanted sound. Quantitative information on the adverse effects of airborne noise on people is well documented. For example, noise may interfere with human activities, such as sleep, speech communication, and tasks requiring concentration or coordination. If sufficiently loud, it may also cause hearing damage, and other physiological problems. The threshold of discomfort is 120 dB, and the threshold of pain is about 140 dB. Although the stated effects of noise on people vary greatly with the individual, several noise scales and rating methods are used to quantify the effects of noise on people. These scales and methods consider such factors as loudness, duration, time of occurrence, and changes in noise level with time.

3.2 NOISE FUNDAMENTALS

3.2.1 Hertz

The human ear experiences sound as a result of pressure variations or vibrations in the air. Thus, sound is generally defined as any pressure variation that the human ear can detect. Sound pressure is measured in micropascals. Although humans can detect a range from 20 to 20 million micropascals, the variations may not register as sound. For example, air pressure changes as a result of weather — high pressure and low pressure systems — are not perceived as sound because they happen too slowly. The air pressure variations must be more frequent. If the variations, or oscillations, in pressure occur between 20 and 20,000 times per second, then they are audible to humans. For example, piano strings vibrate at 27.5 times per second at the lowest notes and 4,186 times per second at the highest notes. This rate of variation or oscillation per second is called frequency and the unit of measurement is called Hertz (Hz).

3.2.2 Sound Pressure Level

The human ear is designed to function in the 20 to 20,000 Hz range. In terms of hearing, however, humans are less sensitive to low frequencies (< 250 Hz) than mid-frequencies (500-1,000 Hz). The human ear is most sensitive to higher frequencies in the 1,000 to 5,000 Hz range (US Department of Transportation, September 1980). High frequency noise is generally more annoying to people than low or mid-frequency noise.

Because humans can detect such a wide range of sound pressures, the numbers are too unwieldy to handle. Therefore, sound pressure is converted to a term known as sound pressure level (SPL), which is based on a logarithmic scale that reflects *relative* changes from a particular reference point (20 micropascals). This logarithmic unit of measure for sound pressure level is called the decibel (dB). 0 dB is the threshold of hearing.

Because noise typically contains a lot of different frequencies, a weighting system has been devised that gives less importance to the low frequencies. Of the different weighting schemes, the one that best corresponds to the response of the human ear is the A-weighted sound level. Decibels on the A-weighted scale are termed “dBA.”

3.2.3 Decibel Addition

Because they are logarithmic, decibels cannot be added and subtracted arithmetically. The formula for adding together SPLs is:

$$L_{total}\ dB = 10 \log \sum_{Li=1}^{N} 10^{(Li/10)}$$

where: Li is an individual SPL and L_{total} is the sum of the SPLs.

Based on this formula, adding together two noise levels that are equally loud would result in a noise level that was 3 dBA higher. Thus, if the noise from a fan on an industrial site is 60 dBA at a residential property line, and a second fan was added at the industrial site, the total noise level at the property line would be 63 dBA, not 120 dBA.

In most cases, where the addition of decibels only needs to be accurate by +/- 1 dB, the following rule of thumb can be used to add decibels:

When two decibel values differ by:	Add the following amount to the higher value:
0 or 1 dB	3 dB
2 or 3 dB	2 dB
4 or 9 dB	1 dB
10 dB or more	0 dB

3.2.4 Human Perception of Noise Level Increase

Because the scale is logarithmic, a relative increase of 10 decibels represents a sound pressure level that is 10 times higher. However, humans don't perceive a 10 dBA increase as 10 times louder; they perceive it as twice as loud. The following is typical of human response to relative changes in noise level:

- 3 dBA change is the threshold of change detectable by the human ear,
- 5 dBA change is readily noticeable, and
- 10 dBA increase is perceived as a doubling of noise level.

Table 3-1 shows the range of noise levels for a variety of indoor and outdoor activities.

3.2.5 Noise Descriptors

The SPL that humans experience typically varies from moment to moment. Therefore, a variety of descriptors are used to evaluate noise levels over time. Some typical descriptors are defined below:

- L_{eq} is the continuous equivalent sound level. The sound energy from the fluctuating sound pressure levels is averaged over time to create a single number to describe the mean energy or intensity level. High noise levels during a monitoring period will have greater effect on the L_{eq} than low noise levels. The L_{eq} has an advantage over other descriptors because L_{eq} values from different noise sources can be added and subtracted to determine cumulative noise levels. The formula for the L_{eq} is:

$$L_{eq} = 10 \log 1/n \sum_{i=1}^{N} 10^{(Li/10)}$$

Table 3-1
Sound Pressure Level and Loudness of Typical Noises in Indoor and Outdoor Environments

Noise Level (dBA)	Subjective Impression	Typical Sources		Relative Loudness (Human Response)
		Outdoor	Indoor	
120-130	Uncomfortably Loud	Air raid siren at 50 feet (threshold of pain)	Oxygen torch	32 times as loud
110-120	Uncomfortably Loud	Turbo-fan aircraft at take-off power at 200 feet	Riveting machine Rock band	16 times as loud
100-110	Uncomfortably Loud	Jackhammer at 3 feet		8 times as loud
90-100	Very Loud	Gas lawn mower at 3 feet Subway train at 30 feet Train whistle at crossing Wood chipper shredding trees Chain saw cutting trees at 10 feet	Newspaper press	4 times as loud
80-90	Very Loud	Passing freight train at 30 feet Steamroller at 30 feet Leaf blower at 5 feet Power lawn mower at 5 feet	Food blender Milling machine Garbage disposal Crowd noise at sports event	2 times as loud
70-80	Moderately Loud	NJ Turnpike at 50 feet Truck idling at 30 feet Traffic in downtown urban area	Loud stereo Vacuum cleaner Food blender	Reference loudness (70 dBA)
60-70	Moderately Loud	Residential air conditioner at 100 feet Gas lawn mower at 100 feet Waves breaking on beach at 65 feet	Cash register Dishwasher Theater lobby Normal speech at 3 feet	2 times as loud
50-60	Quiet	Large transformers at 100 feet Traffic in suburban area	Living room with TV on Classroom Business office Dehumidifier Normal speech at 10 feet	1/4 as loud
40-50	Quiet	Bird calls, Trees rustling, Crickets, Water flowing in brook	Folding clothes Using computer	1/8 as loud
30-40	Very quiet		Walking on carpet Clock ticking in adjacent room	1/16 as loud
20-30	Very quiet		Bedroom at night	1/32 as loud
10-20	Extremely quiet		Broadcast and recording studio	
0-10	Threshold of hearing			

Sources: Noise Assessment Guidelines Technical Background, by Theodore J. Schultz, Bolt Beranek and Newman, Inc., prepared for the US Department of Housing and Urban Development, Office of Research and Technology, Washington, D.C., undated; Sandstone Environmental Associates, Inc.; Highway Noise Fundamentals, prepared by the Federal Highway Administration, US Department of Transportation, September 1980; Handbook of Environmental Acoustics, by James P. Cowan, Van Nostrand Reinhold, 1994

- L_{dn} is the day-night equivalent sound level. It is similar to a 24-hour L_{eq}, but with 10 dBA added to SPL measurements between 10 pm and 7 am to reflect the greater intrusiveness of noise experienced during these hours. L_{dn} is also termed DNL.

- L_{max} is the highest SPL measured during a given period of time. It is useful in evaluating L_{eq}s for time periods that have an especially wide range of noise levels.

- L_{min} is the lowest SPL measured during a given period of time.

- L_{10} is the SPL exceeded 10% of the time. Similar descriptors are the L_{50}, L_{01}, and L_{90}.

3.2.6 Octave Bands

Although the SPL heard in the environment typically is composed of many different frequencies, it can be broken down into numerous individual frequencies. These frequencies are grouped into octave bands. An octave band is a group of frequencies in the interval between a given frequency (such as 350 Hz) and twice that frequency (e.g., 700 Hz). The standard octave bands are each named by their center frequencies. Thus, each octave band will be represented by a single SPL. When the representative SPLs from the individual octave bands are added together, they are weighted so that the resulting total SPL will represent dBA. Octave bands are used in some noise models because the different components of a noise source will have different frequencies. For example, a truck traveling downhill will have a different set of frequencies than a truck traveling uphill.

3.2.7 Sound Power Level

Another term used in noise analysis, which also can be termed SPL and which also can be measured in decibels, is sound power level (PWL or L_w). Whereas sound pressure level is relative to a reference level of 20 micropascals, sound power level is the total sound power emitted by a source in all directions. Typically, sound power level is measured in picowatts (10^{-12} watt). The formula for converting sound power level to decibels is:

$$L_w = 10 \log_{10} (W/W_o)$$

where: L_w is the sound power level,
W is the measured sound power in watts, and
W_o is a reference power, usually 1×10^{-12}W

Sound power level is often used in models of stationary noise sources, such as industrial equipment. Like sound pressure level, sound power level usually is composed of multiple frequencies.

3.2.8 Transmission Loss

Transmission loss is the reduction in noise between source and receiver that occurs when noise cannot penetrate a wall, window, or other intervening object. The difference between the noise level on one side of a barrier and the noise level on the other side of a barrier is the transmission loss (TL). A 22-gauge steel exterior wall in an industrial building may have an overall transmission loss of 25 dBA. Thus, total noise from equipment located inside the building would be 25 decibels lower outside the building due to the intervening wall. The TL is different for each octave band, and the individual TLs are logarithmically summed to obtain a single number in dBA that represents the overall TL for a given intervening surface.

TL is calculated from a transmission coefficient (tau, or *t*) that varies with frequency. *t* can vary from a value of 0, where the material blocks all noise, to 1, where the material does not block any of the noise. "Break-out" noise occurs when noise escapes through an opening in a building, such as a duct or opening for a conveyor belt, that has a transmission coefficient of 1 for that portion of the wall. The formula for calculating TL is:

$$TL = 10 \text{ x } \log(1/t)$$

Conversely, if the TL is known, then *t* can be calculated by the following equation:

$$t = 1/(10^{(TL/10)})$$

t typically increases with the octave band frequency; thus, noise levels at the higher frequencies are more easily blocked than noise levels at the lower frequencies. This is another reason why power plant noise in the octave bands of 500 and lower are of greatest concern in projecting potential impacts.

Where the exterior of a building is composed of walls, windows, doors and openings with different TLs, a composite TL for one side of the building can be calculated as shown by the following equation from Cowan (1994):

$$t_{composite} = (t_1S_1+t_2S_2+t_3S_3\ldots t_nS_n)/S_{total}$$

Where: t_1, t_2,…....t_n = transmission coefficients for each different component of the wall,
S_1, S_2…..Sn = the surface areas for each of the different components of the wall, and
S_{total} = the total surface area for the wall.

3.3 NOISE SOURCES

3.3.1 Sources of Truck Noise

Truck noise includes noise from the wheel-road interface as well as the engine and brakes. Engine noise includes exhaust noise, casing-radiated noise from the engine block and covers, and engine cooling-fan noise. The dominant component of truck noise depends on the engine speed, engine load, and muffler. However, engine cooling-fan noise typically dominates, particularly in new trucks outfitted with more efficient mufflers (Cavanaugh and Tocci, 1998). Engine noise typically dominates at lower speeds, and old trucks are much noisier than newer trucks. The difference between a truck that is more than 10 years old and a new, high-end truck is as much as 30 dBA at high speeds, because most new trucks have standard sound packages. Truck engines typically are noisier during acceleration and deceleration than when traveling at a constant speed.

Tire noise tends to dominate at higher speeds unless the truck is operating with a poorly maintained muffler. Studies have found that engine noise increases about 5 dB as speed increases from 10 mph to 40 mph, regardless of pavement type. However, noise from the rear tires of a heavy truck can increase by as much as 20 dBA as speed increases from 10 mph to 40 mph (Mackenstrum et al 2002).

Some pavements reduce truck tire noise. New asphalt is quieter than old asphalt because small pockets at the surface of the road trap air as the tires roll over it. After a few weeks of use, the pavement becomes smoother, and the air between the tires and smoother roadway is rapidly trapped, compressed, and released, resulting in louder tire noise (Cavanaugh and Tocci, 1998). At night, truck tire noise is more noticeable because fewer autos are in the traffic mix to help mask the noise. Research is currently underway in the US and other countries to experiment with roadway surfaces that would help reduce noise from the tire/road interface.

Another source of noise for trucks is the use of Jake Brakes. These brakes may be responsible for some of the peak noise levels from passing trucks. Jake Brakes, manufactured by Jacobs Vehicle Systems, are mounted on the engine overhead above the valves, where they turn the engine into a giant air compressor that acts as a supplemental braking system. Typically, they are used on the larger class 7 and 8 trucks. They control vehicle speed with minimal use of wheel brakes on downhill grades, reducing the potential for overheated brakes, reducing wheel brake maintenance frequency and increasing the life of the tires. Because the engine brake noise is a component of exhaust noise, it can be controlled with a properly functioning muffler. Although some communities claim that Jake Brakes substantially increase the noise levels, Jacobs Vehicle Systems claims that truckers tampering with mufflers is the primary source of the increased noise levels. High performance mufflers have been developed to further reduce the noise from the engine and engine brake system.

3.3.2 Sources of Equipment Noise

Sources of noise from equipment include the sound of motors and engines, high-frequency back-up alarms, and materials handling. Conveyors used to transport materials onsite may generate noise through the cable and pulleys as well as the engine. Conveyor noise can also be caused by impacts and scraping at locations along the conveyor structure. Other noise from materials handling occurs when trucks dump stones or other material onto piles, when the material is moved from one location to another by front loaders, and when materials are crushed.

3.4 NOISE ATTENUATION AND MITIGATION

Noise from a given source attenuates (diminishes) with distance. A roadway or railway is considered a line source because a motor vehicle or diesel engine moves from one point to another along a fixed linear route, and the receiver experiences noise from all points along the line. Noise from a line source typically attenuates at the rate of 3 dBA per distance doubling, based on a reference distance of 50 feet. Thus, a traffic noise level of 65 dBA at a distance of 50 feet from the roadway would be 62 dBA at a distance of 100 feet from the roadway. It would be 59 dBA at a distance of 200 feet from the roadway. The 3 dBA attenuation rate is used for noise traveling through the air or over a hard surface. Noise traveling over a soft surface, such as grass, may attenuate at a more rapid rate of about 4.5 dBA.

Noise from industrial equipment at a fixed location is termed a stationary source or point source. It attenuates at a rate of 6 dBA when noise is traveling through air or over a hard surface, and up to 7 or 8 dBA when traveling over a soft surface. These attenuation rates are general rules for total noise levels from a given source. For the individual octave bands that comprise the total noise, the attenuation rate is greater for high frequencies (4000 – 8000 Hz) than for lower frequencies. Noise in the octave bands of 500 and lower are of particular concern in the analysis of noise from power plants due to their slower attenuation rate with distance.

4. NOISE LEGISLATION AND EVALUATION CRITERIA

4.1 FEDERAL

4.1.1 Environmental Protection Agency

Studies carried out by the Environmental Protection Agency (EPA) on the effects of noise are the basis of standards and legislation at federal, state, and local levels of government. Prior to the Federal Noise Control Act of 1972, most states and municipalities regulated noise under general ordinances for creating a nuisance or disturbing the peace. In 1973, the EPA published a “Criteria Document” that established criteria for assessing the effects of noise on public health and welfare. In 1974, EPA published the “Levels Document,” a summary of noise levels identified as requisite to protect public health and welfare with an adequate margin of safety. For the purposes of hearing conservation, EPA determined that an $L_{eq(24)}$ of 70 dBA would be sufficient to protect people.

EPA’s recommended 70 dBA criterion for public health and welfare is not low enough to prevent people from being annoyed by noise. Noise causes annoyance when activities such as talking, watching TV, or sleeping are interrupted. EPA found that when the background noise level is 55 dBA, conversation between two individuals is 95% intelligible at a distance of about 10 feet. As background noise increases, they must move closer to maintain 95% intelligibility. At 65 dBA, the distance decreases to about five feet.

EPA determined that an indoor L_{dn} of 45 dBA permits normal speech communication in the home. At night, an indoor background noise level of 32 dBA is needed for most people to sleep without interference. Most homes, can provide an exterior to interior noise level reduction of 15 dBA, even if the windows are partially open. Thus, an outdoor noise level of 60 dBA would result in an indoor noise level of 45 dBA. However, EPA allowed for a 5 dBA margin of safety in recommending an outdoor noise level of 55 dBA in residential areas. These noise levels recommended by EPA are guidelines. They are not federally enforceable regulations.

In addition to recommending guidelines for total noise in residential areas, the Noise Control Act of 1972 also gave the EPA the authority to establish noise regulations to control major sources of noise, including transportation vehicles and construction equipment. Pursuant to this legislation, EPA established regulations that set noise emission level standards for newly manufactured medium and heavy trucks that have a gross vehicle weight rating (GVWR) of more that 4,525 kilograms (10,000 lbs) and are capable of operating on a highway or street. Table 4-1 shows the maximum noise emission levels allowed by the EPA noise regulations for these vehicles.

Table 4-1
Maximum Noise Emission Levels as Required by EPA for
Newly Manufactured Trucks with GVWR over 4,525 Kilograms (10,000 lbs)

Effective Date	Maximum Noise Level 15 Meters (50 feet) from Centerline of Travel*
January 1, 1988	80 dBA

*Using the Society of Automotive Engineers, Inc. (SAE), test procedure for acceleration under 56 kph (35 mph)
Source: US Environmental Protection Agency

For existing (in-use) medium and heavy trucks with a GVWR of more than 4,525 kilograms, the federal government has authority to regulate the noise emission levels only for those that are engaged in interstate commerce. Regulation of all other in-use vehicles must be done by state or local governments. The EPA emission level standards for in-use medium and heavy trucks engaged in interstate commerce are shown in Table 4-2 and are enforced by the FHWA Office of Motor Carrier Safety (OMCS).

Table 4-2
Maximum Noise Emission Levels as Required by EPA for In-Use Medium and Heavy Trucks with GVWR Over 4,525 Kilograms (10,000 lbs) Engaged in Interstate Commerce

Effective Date	Speed	Maximum Noise Level 15 Meters (50 feet) from Centerline
January 8, 1986	< 56 kph (35 mph)	83 dBA
January 8, 1986	> 56 kph (35 mph)	87 dBA
January 8, 1986	Stationary	85 dBA

Source: US Environmental Protection Agency

4.1.2 Federal Interagency Committee on Urban Noise

Many urban areas already exceed a background L_{dn} of 55 dBA. In 1980, the Federal Interagency Committee on Urban Noise developed land use compatibility guidelines that included federal agencies' consideration of general cost and feasibility factors, as well as past community experiences and the objectives of various programs. These guidelines permitted an L_{dn} of 55 to 65 dBA in residential areas. The upper limit, an L_{dn} of 65, has been used by federal agencies in establishing a threshold noise level for identifying areas that are considered to be significantly impacted by noise levels.

4.1.3 U.S. Department of Housing and Urban Development

Based on the EPA reports, the Department of Housing and Urban Development published regulations establishing standards for HUD-assisted projects in 1979. HUD categorized noise levels for proposed residential development as acceptable, normally unacceptable, and unacceptable, as shown in Table 4-3. HUD assistance for construction of new noise sensitive uses is generally prohibited for projects with unacceptable noise exposures, and is discouraged for projects with normally unacceptable noise exposure.

Table 4-3
HUD Acceptability Standards for Noise

Category	Noise Level (L_{dn})
Acceptable	≤ 65 dBA
Normally Unacceptable	>65 dBA ≤ 75 dBA
Unacceptable	> 75 dBA

Source: U.S. Department of Housing and Urban Development, March 1985

The assumption is that standard construction provides an average of 20 L_{dn} of attenuation. At 65 L_{dn} or below, this amount of attenuation would be sufficient to meet an interior level of 45 L_{dn}. HUD-financed buildings constructed in Normally Unacceptable or Unacceptable areas must provide sufficient sound attenuation, as specified by HUD, to reduce interior noise levels to an L_{dn} of 45 dBA.

The Noise Guidebook, published by HUD in 1985, states that sites in the vicinity of federally funded highways are subject to the noise analysis procedures of the Federal Highway Administration (FHWA). To convert the FHWA analyses to relevant HUD criteria, the Guidebook recommends the following rules of thumb:

- L_{dn} ≈ the peak-hour L_{10} – 3 decibels, or
- L_{dn} ≈ the peak-hour $L_{eq.}$

These formulas assume that off-peak noise levels are lower than peak noise levels, and that nighttime noise levels are lower than daytime noise levels. In addition, heavy trucks must not exceed 10% of the 24-hour traffic volume, and traffic flow between 10 pm and 7 am must not exceed 15% of the average daily traffic flow. Another rule of thumb used in analyzing environmental noise levels is that nighttime noise levels are approximately 10 dBA lower than daytime noise levels.

4.1.4 Federal Highway Administration

The FHWA has standards that govern the analysis and definition of impacts for traffic noise for projects using federal-aid funds for highway projects. They are described in FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise* contained in 23 CFR 772. FHWA established Noise Abatement Criteria (NAC), shown in Table 4-4, to be used in defining traffic noise impacts. An impact is defined when projected traffic noise levels: 1) approach or exceed the NAC, or 2) substantially exceed existing noise levels. FHWA did not intend the NAC to be used as federal standards, desirable noise levels, or design goals for noise barriers. They are only to be used as absolute values that, when approached or exceeded, require consideration of traffic noise mitigation measures.

The FHWA regulations do not specify noise levels that approach or exceed the NAC; state departments of transportation (DOTs) develop their own definitions. However, FHWA guidelines require state DOTs to use a definition of "approach" that is at least 1 dBA less than the applicable NAC. State DOTs also develop their own criteria for determining a “substantial” increase in noise levels. Table 4-5 shows some of the criteria that state DOTs have used to define a substantial increase in noise levels. These state DOT criteria fall into 3 general groupings. All groupings identify relative noise level increases of up to 5 dBA as having little or no effect on perceptions of noise. All groupings also identify an impact (i.e., a substantial increase in noise) as a relative increase of at least 10 dBA, and some place that level at 15 dBA or more.

A noise level that exceeds the NAC under Build Conditions is defined as an impact, *even if the noise exceeded the NAC under Existing or No Build conditions*. This comparison of Build and Existing conditions is appropriate for a federally-funded highway improvement project where the highway itself is a predominant source of noise under Existing and No Build conditions, as well as Build conditions. In addition, the difference in traffic volumes between No Build and Build conditions may be small where the highway is being improved to alleviate congestion .

The FHWA criteria are not applicable for private development projects, which have no influence on existing conditions. In addition, no barriers can be constructed along state and county roads where homes and businesses require driveway access at frequent points along the road. Nevertheless, the FHWA criteria occasionally have been used to evaluate noise levels from project-generated traffic in urban areas where no other standard applies. In these cases, the threshold for considering mitigation measures is based on state DOT interpretations of FHWA guidelines, except that the comparison is between No Build and Build conditions rather than Existing and Build conditions.

4.1.5. Federal Energy Regulatory Commission

In its *Guidance Manual for Environmental Report Preparation*, published in August 2002, the Federal Energy Regulatory Commission recommended that compressor facilities not exceed an L_{dn} of 55 dBA at noise-sensitive areas.

Table 4-4
FHWA Noise Abatement Criteria

Activity Category	Hourly Sound Level (dBA)*		Description of Activity Category
	L_{eq}(h)	L_{10}(h)	
A	57 (Exterior)	60 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve it
B	67 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, sports acres, parks, residences, motels, hotels, schools, churches, libraries, and hospitals
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above
D	--	--	Undeveloped lands
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums

**Either L_{10} (h) or L_{eq} (h) (not both) may be used on a project. Hourly sound levels are expressed in dBA (decibels on the A-weighted scale), which correlate with human perception of loudness.*
Source: 23 CFR 772

Table 4-5
State Criteria to Define Substantial Increases in Noise Level

Criteria Group	Relative Increase (dBA)	Subjective Descriptor
1	0-5 5-15 >15	Little increase Some increase Substantial increase
2	<10 >10	Little increase Substantial increase
3	0-5 5-10 10-15 >15	No increase Minor increase Moderate increase Substantial increase

Source: 23 CFR 772

4.2 STATE OF WEST VIRGINIA

4.2.1 West Virginia Department of Environmental Protection

The West Virginia Department of Environmental Protection (WVDEP) currently has no noise guidelines that would address noise concerns for the proposed power plant.

4.2.2 West Virginia Department of Transportation

The West Virginia Department of Transportation (WVDOT), Division of Highways, has a design directive (DD-207) dated February 6, 1998, entitled “Noise Analysis and Abatement Guidelines.” Applicable to highway projects, it states that existing noise levels should be determined according to FHWA’s “Sound Procedures for Measuring Highway Noise, Final Report” as a guide. Future noise level predictions are to be determined using the FHWA highway traffic noise prediction model as a guide. In identifying traffic noise impacts, DD-207 indicates that an impact would occur when predicted noise levels approach (are within 1 dBA (L_{eq})) of the FHWA NAC or substantially exceed the existing noise levels by at least 16 dBA.

4.2.3 Public Service Commission of West Virginia

Under Title 150 of the West Virginia Code, the Public Service Commission is in the process of promulgating Series 30: Rules Governing Siting Certificates for Exempt Wholesale Generators. The definition of an exempt wholesale generator (EWG) includes the proposed WGC facility. When the requirements for a siting certificate have been finalized, and if they are applicable to the ongoing WGC facility, they will be considered as an addition to this report document.

4.3 LOCAL ORDINANCES

No local ordinances apply to this study. Neither Greenbrier County nor the City of Rainelle has a local ordinance that addresses noise from new development or construction activities. Traffic volumes on state and county roadways are outside the jurisdiction of local noise ordinances.

4.4 EVALUATION CRITERIA FOR WGC PROJECT

4.4.1 Transportation Corridors

A review of noise levels for Existing Conditions indicates that many locations along the Route 20/60 corridor currently experience a peak hour L_{eq} of 65.0 dBA or higher. Using the peak-hour L_{eq} as an approximation of the L_{dn} indicates that these locations have L_{dn}s that exceed the HUD guideline of 65 dBA, as well as L_{eq}s that exceed the FHWA guideline of 67 dBA. Therefore, the HUD and FHWA guidelines that specify an absolute noise level for determining potential impacts would not be applicable along the transportation corridors. Instead, a more appropriate impact criterion would be a relative increase in noise between No Build and Build conditions. In determining an appropriate impact criterion, the following perceptions of noise level increases were considered, based on Table 4-2:

- 0 to 5 dBA – Minor increase in noise level
- 5 to 10 dBA – Readily noticeable increase in noise level
- 10 or more dBA – Significant increase in noise level

The proposed criterion for determining project-generated impacts at sensitive receptors dominated by traffic noise along the transport roadways is a relative increase of 10 dBA. This criterion is lower than the WVDOT increment of 16 dBA, but was selected because it is perceived as a doubling of noise level, and is typical of impact criteria used by many state DOTs.

4.4.2 Sites in Vicinity of Plant

A review of Existing Conditions for monitored sites in the vicinity of the plant site indicates that L_{dn} noise levels range from 41.4 dBA to 54.0 dBA. It is important to note that these levels are based on baseline measurements that occurred during the winter months, and baseline conditions are expected to be higher during seasons when birds and insects are present and actively making noise. In the absence of applicable local requirements for the project, an L_{dn} of 60 dBA was selected to be the threshold for significant impacts at noise sensitive sites in the vicinity of the plant. An L_{dn} of 60 dBA would be equivalent to a continuous noise level of 53.6 dBA. The 60 L_{dn} level would be up to 12 dBA higher at some sites but it is similar to existing conditions at some of the other monitored sites. HUD's criterion of a 65 L_{dn} would be equivalent to a constant noise level of 58.6 dBA.

5. PREDICTIVE NOISE MODELS

5.1 TRAFFIC NOISE MODEL (TNM)

The FHWA Traffic Noise Model (TNM), Version 2.5, calculates noise levels based on traffic volume, vehicular mix, vehicular speed, roadway and receptor elevations, rows of buildings, and terrain features. The model also accounts for:

- Slow-speed and accelerating vehicles
- Bus and motorcycle data
- Vehicles on grade
- Vehicles on different pavement types

Other aspects of the noise emission data include energy apportioned to two source heights: one at the pavement level and one at 1.5 meters (5 feet) above the pavement, except for heavy trucks, where the upper height is 3.66 meters (12 feet) above the pavement.

The effects of traffic acceleration away from traffic signals, stop signs, toll booths, and on-ramp start points are included in the model, and the TNM computes vehicle speeds and noise levels accordingly. The TNM incorporates state-of-the-art sound propagation and shielding algorithms over ground of different types, atmospheric absorption, and the shielding effects of barriers, berms, ground, buildings, and trees. The TNM propagation algorithms assume neutral atmospheric conditions but do not account for atmospheric variables such as wind or temperature gradients.

To ensure that the modeled results accurately reflect the site conditions, the TNM model typically is calibrated by using the traffic counted concurrently during the noise monitoring as input. The resulting modeled noise levels for the monitored sites were within 1 dBA of the monitored noise levels except where the sites were affected by conditions other than traffic. This included sites somewhat distant from the roadway so that traffic noise attenuated to levels below background levels. Thus, the modeled noise levels were much lower than monitored noise levels. It also included situations where barking dogs or noisy birds contributed to the monitored noise level, resulting in modeled traffic noise levels that were lower than the monitored noise levels.

After calibration of the monitored sites, the TNM model was run using the volumes, vehicular mix, and speeds provided by the traffic analysis for Existing, No Build, and Build conditions. This traffic information is based on worst-case conditions, which may not have been present during the monitoring periods.

5.2 CADNA MODEL

The Computer Aided Noise Abatement (CADNA 3.4) Model quantifies industrial noise sources using The International Environmental Noise Directive and ISO guidelines to accurately describe ambient noise in community environments. CADNA integrates aircraft, rail, and motor vehicle traffic, as well as industrial noise sources, into a seamless platform to predict A-weighted L_{dn}, L_{eq}, and SPL values. Noise results can be analyzed one-dimensionally at receptors, two-dimensionally through contour grids, and three-dimensionally using profile and digital terrain perspectives. Noise remediation measures are assessed using several program capabilities including barriers, natural embankments, and on-site attenuation measures such as sound reducing materials and equipment silencers.

Based on available site layout and design data, the following parameters were emphasized in the model developed for the WGC project:

- Terrain – All other objects (buildings, roads, railways, etc.) were configured.
- Ground – A concrete reflective surface was defined for the power plant site.
- Structures – The geometries, materials, and in some cases overall noise spectra, were assigned to each building based on their internal noise sources.
- Machinery – Exposed noise sources were defined with minimal or no shielding.

Additional factors addressed for the structures and machinery emitting noise were elevations, points of noise breakout or transmission (windows, openings, louvers, doorways), and known attenuation measures that were associated with specific pieces of equipment.

On-site noise sources for the WGCP were modeled point sources (an unenclosed stationary source) or area sources (a group of noise sources within a building or enclosure). The stationary sources are directly modeled by CADNA. For the area sources, however, the user must provide average noise levels at the interior walls of a building, calculate the composite TL for each wall, then subtract the composite TL from the average interior wall noise to determine the average exterior wall noise level. The average exterior noise level for each wall is then modeled as an area source with a size equal to the surface of the wall. Additional information on the use of the CADNA model is provided in the discussion of Build Conditions.

6. NOISE MONITORING PROGRAM

6.1 SELECTION OF MONITORING SITES

A noise monitoring program was designed and implemented for sites along arterial roadways and sites near the proposed power plant location. Sites in Rainelle would be affected by both increased traffic noise and power plant noise. Five other municipalities that could be affected by project-generated traffic noise include Charmco, Rupert, Anjean, Quinwood, Green Valley, and Hillsboro. Monitoring sites along the arterials were selected to represent typical sensitive receptor points in the affected municipalities, while sites in the vicinity of the proposed power plant were selected to identify baseline conditions in noise sensitive areas that are not dominated by traffic noise.

Noise monitoring was carried out during site visits on 5/11/04 to 5/13/04, 10/19/04 to 10/21/04, 1/12/05 to 1/13/05, and 11/03/05. Monitoring of the Hillsboro area, which is near the Millpoint Quarry, occurred on 11/3/05. Three sound level meters were used in this study: a Brüel & Kjær 2236 and Larson-Davis 820 (both ANSI Type 1), and a Quest 2200 (Type 2). Noise monitoring included peak AM, Midday, PM, off-peak, and late night periods on weekdays. Some weekend periods also were monitored. Table 6-1 shows the list of monitored sites, and Figure 6-1 depicts their locations.

6.2 TRAFFIC NOISE SITES

In Rainelle, traffic noise sites were monitored in four residential areas (designated A, B, C, and D). Representative receptor sites in six areas (designated E through J) in five additional towns along the arterials for site-generated truck traffic were also selected. These are shown in Figures 6-1 through 6-2. Multiple locations within an area were sometimes monitored to ensure that TNM modeling would account for the complexity of different roadway-receptor configurations at an intersection. Monitoring sites at points selected solely for the purposes of assisting in model calibration, or selected for evaluation of rail noise (no longer included in the proposed action), are not included in the discussion. A 15-minute monitoring period was used, which corresponded with the traffic counts conducted by the traffic analysis team. In some cases, however, monitoring had to be stopped after a 10- to 12-minute period due to the start-up of extraneous noises such as a barking dog or freight rail passby.

The following standard field procedures were observed when collecting noise measurements:

- Field notes documented instrument range, weather conditions, time of day, monitoring period, unusual occurrences (e.g., aircraft flyovers), and site characteristics,
- B&K 2236 noise analyzer and Quest 2200 noise analyzer were used
- Free field microphone mounted approximately 5 feet (1.5 meters) high and at least 4 feet (1.2 meters) from any reflecting surfaces,
- Monitors calibrated every hour,
- Wind screen used on microphone,
- Traffic counts and vehicle classifications taken concurrently (when possible),
- Distance from receptor to edge or middle of road was measured (when possible),
- Roadway speed limit, geometry, and grade (on special occasions) were recorded,
- No monitoring during periods of precipitation, wet pavement, snow or ice cover, and
- No monitoring in winds of 15 mph (24 kph) or more.

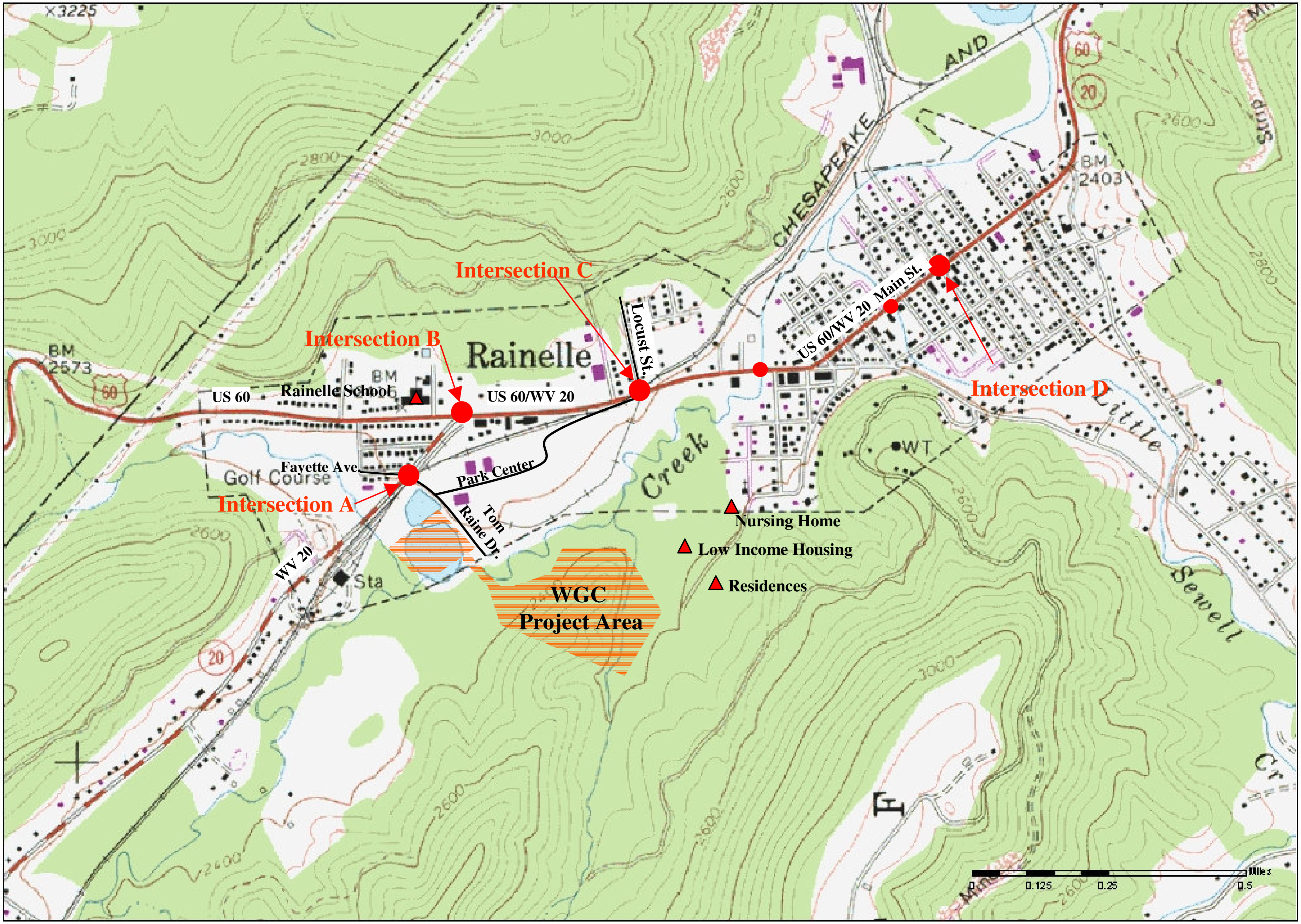

Figure 6-1
WGC Noise Monitoring Locations A through D (Rainelle, WV)

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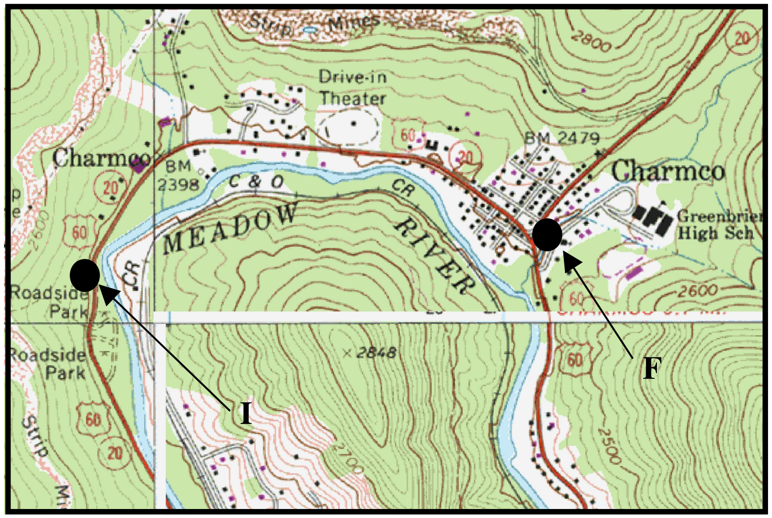
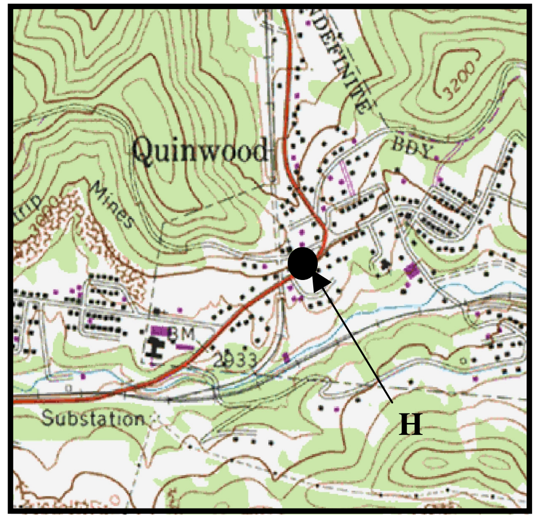
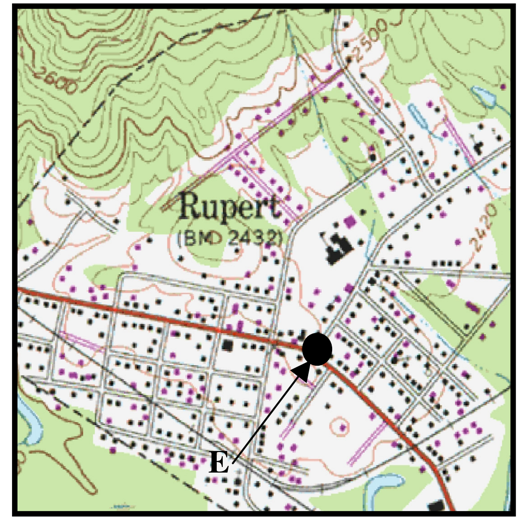
May 2006



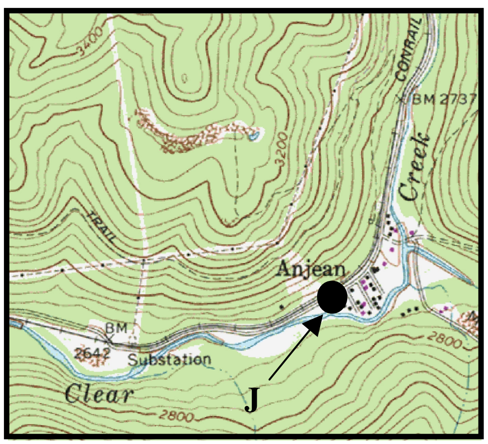
I and F - Charmco



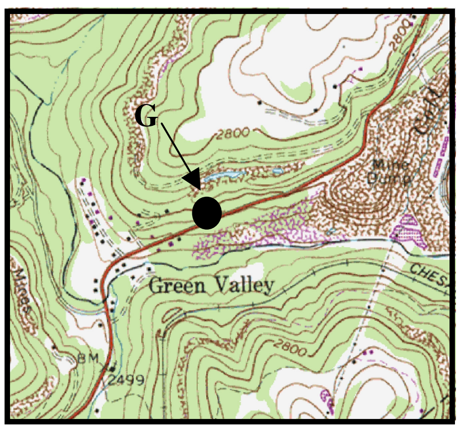
H - Quinwood



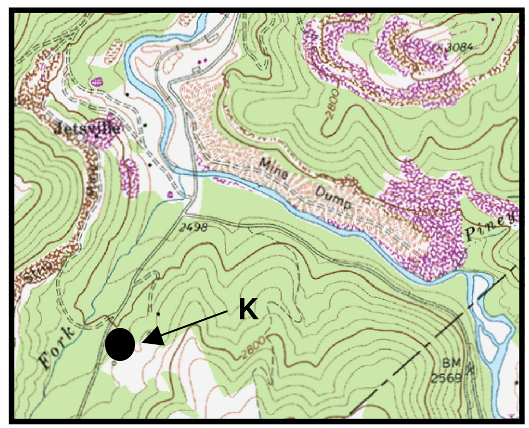
E - Rupert



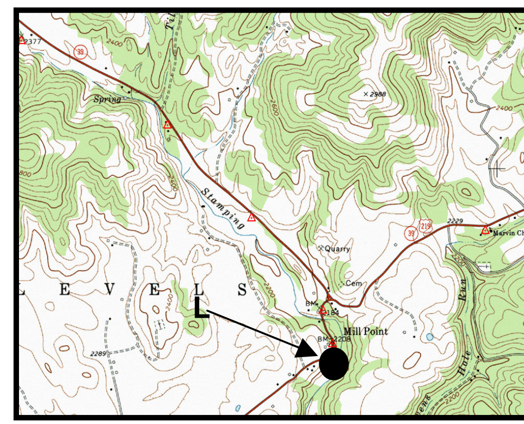
J - Anjean



G – Green Valley



K – Donegan Site



L – Mill Point

NOT TO SCALE

Figure 6-2 Noise Monitoring Locations – E through L Map Source: USGS Topo (1:24,000) Rainelle (1976), Quinwood (1981), Rupert (1981), Duo (1981)	Noise Monitoring and Predictive Modeling Technical Report	Western Greenbrier Co-Production Demonstration Project May 2006

Table 6-1
Noise Monitoring Sites

Area	ID	Location / Landmark	Type T/P	Monitoring Periods Peak	Off-Peak	Late Night	Week-end
Short-Term Noise Monitoring Locations							
A	1	State police barracks	T	X	X	X	X
A	3	Playground	T	X	X	X	X
A	5	Golf Course	T	X	-	-	-
A	6	Greenbrier Ave./Rte 20	T	-	X	-	-
A	7	Walnut Street	T	X	X	-	X
A	8	Grace Baptist Church	T	X	X	-	-
B	1	Rainelle Medical Ctr.	T	X	-	X	-
B	2	Rainelle Elementary	T	X	-	-	-
C	1	North Sewell Street	T	X	-	X	-
C	4	Cherry Street	T	X	-	-	-
C	5	Nicholas Street	T	X	-	-	-
C	7	Retirement Community	P	X	X	X	-
C	8	Nursing Home	P	-	X	X	X
C	9	ADA housing	P	X	X	X	X
C	10	Mobile Home Park	P	-	X	X	X
D	0	Seventh Street	T	X	X	X	-
E	0	Route1, Rupert	T	X	X	X	-
F	0	Route 60, Charmco	T	X	X	X	-
G	0	Route 20, Green Valley	T	X	X	X	-
H	0	Route 20, Quinwood	T	X	X	X	-
I	0	Route 20, Youth Park	T	X	X	X	-
J,K	0	Anjean Mountain, Donegan	T	X	X	-	-
L	0	Hillsboro, Route 219 north of Lewisburg (Mill Point)					
Long-Term Noise Monitoring Locations							
Site	LT1	Plant - Southeast Side	P	X	X	X	X
Site	LT2	Plant - East Side	P	X	X	X	X
Site	LT3	Plant - North Side	P	X	X	X	X
Site	LT4	Plant - West Side	P	X	X	X	X
Site	LT5	Eco-Park	P	X	X	X	X
Site	LT6	Pennsylvania Avenue	P	X	X	X	X

Type – ‘T’ sites are dominated by traffic noise; ‘P’ sites are dominated by rural background noise in the vicinity of the power plant site;
Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
Off Peak – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
Late Night – Time frames after 10 pm, Monday through Thursday
Weekend – Time frames during off peak periods on the weekend
Source: Potomac Hudson Engineering, Inc.

Area A lies north and west of the power plant site, and it represents noise levels along Route 20 between the intersection with Route 60 near the Rainelle Medical Center and the CSX Railroad facility further to the south on Route 20. These sites are influenced primarily by vehicular traffic. Site A1, the WV State Police barracks at the intersection of Route 20 and Fayette Avenue, is representative of the single-family home at the corner of Route 20 and Fayette Avenue. Additional sites representing land uses that may be adversely affected by noise level increases on Route 20 include the playground at A3, the golf course at A5, the residence at A6 and the Grace Baptist Church at A8. Site A7 on Walnut Street represents residences on local streets in the triangle between Route 20 and Route 60.

Area B also is north and west of the power plant site. It includes homes near the Rainelle Medical Center at the intersection of Routes 20 and 60 (B1), as well as homes and the Rainelle Elementary School further west on Route 60 (B2).

Area C is at the intersection of Route 20/60 and Locust/North Sewell Streets. The dominant noise source is traffic on Route 20/60, including traffic in and out of the shopping center. Site C1 is a residence at the corner of the intersection. Sites C4 and C5 represent additional locations, further from the highway, in the Locust/North Sewell Streets neighborhood.

The remaining monitoring locations include Area D, which represents noise levels in downtown Rainelle; Area E, which represents residences at the intersection of Route 1 (Anjean Road) and Route 60 in Rupert; Area F, which represents the homes at the intersection of Route 60 and Route 20 in Charmco; Area G, which represents homes along Route 20 in Green Valley; Area H, which represents homes along Route 20 in Quinwood; Area I, which is at the Western Greenbrier Youth Park on Route 20/60; Area J, which represents the residences on Route 1 near the entrance to the mining site; and.Area L, which represents homes near Route 219 in the vicinity of Mill Point. Area K (Donegan) was not monitored because the noise sources and noise levels would be similar to Area L.

6.4 WGC PLANT NOISE SITES

Both short-term and long-term monitoring was carried out at locations representing sites that could be affected by noise from the power plant. Sites C7 through C10 are short-term sites within Area C. They are in a quiet residential area that is not affected by highway noise, but could be affected by noise from the power plant.

Long-term monitoring of ambient noise was carried out at the boundaries of the power plant site, as well as at nearby residences. These monitoring locations are depicted in Figure 6-3. Traffic noise from the highway is not significant at these long-term monitoring locations. Due to the overall quiet nature of these sites, these areas may be especially sensitive to future industrial noise generated by the plant. For this reason, the sites were monitored for consecutive periods of 24 hours. The long-term monitoring used six Larson-Davis 820 meters: four placed on three sides of the future plant location, one at the future Eco Park, and one in the adjacent neighborhood. The following field procedures were observed for each long-term monitoring site:

- Field notes documented instrument range, weather conditions, internal device temperature, time of day, and normal/abnormal noise observations;

- Larson-Davis Environmental Noise Monitoring Systems were used, which included environmental shroud with silica-gel desiccant chamber for guarding against humidity and wet weather conditions, weatherproof casing, outdoor microphone preamplifier, stainless steel tilt-down tripod, and a 12V 17 Ah external power source;

- Field microphone mounted approximately 8 feet high and at least 4 feet from any reflective surfaces;

- Monitoring was suspended during periods of stormy weather;

- Monitoring was continued in mildly windy or flurry conditions;

- Monitor locations were surveyed using GPS;

- Monitors' power supplies, hardware setup and downloaded reports were periodically checked; and

- Mobile meteorological stations were used to document weather conditions.

6.5 USE OF MONITORED DATA

The monitoring program produced a large volume of data. After reviewing the data, some readings were discarded due to influence from extraneous noises, short (less than 10 minutes) monitoring periods due to extraneous noise or inclement weather, or equipment malfunction. Data from the traffic sites was used to calibrate the TNM model prior to running the model with traffic for Existing Conditions. Because the traffic observed in the field may not be indicative of typical worst-case traffic volumes, monitored values typically are not used for Existing Conditions. For the non-traffic sites, however, the monitored values were used to characterize the Existing Conditions. Data from the long-term monitoring sites was converted to 24-hour L_{eq}s and L_{dn}s for this purpose.

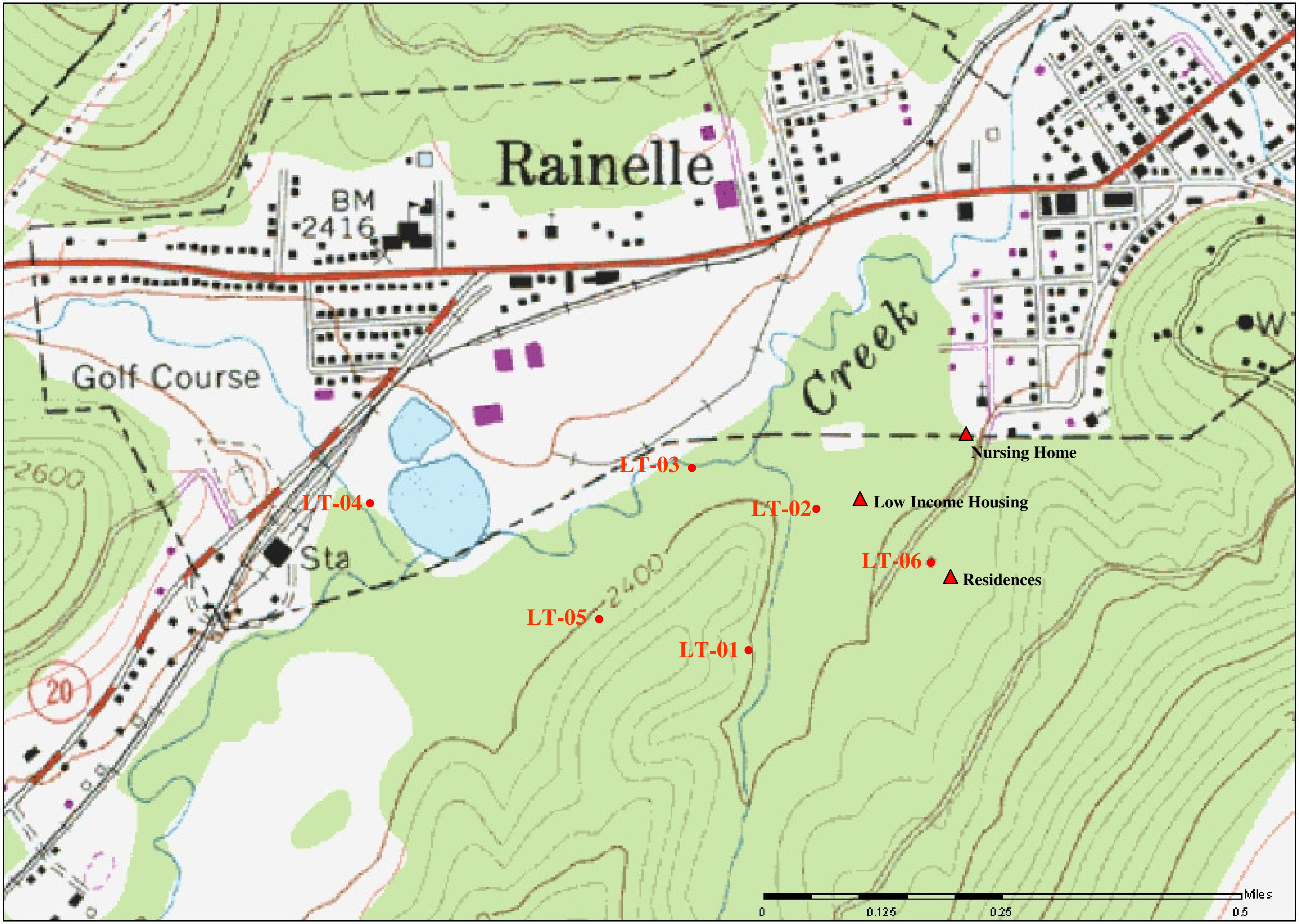


Figure 6-3
WGC Long-Term Noise Monitoring Locations (Rainelle, WV)

Noise Monitoring and Predictive Modeling Technical Report

Western Greenbrier Co-Production Demonstration Project

May 2006

7. EXISTING CONDITIONS

7.1 TRAFFIC SITES

Table 7-1 shows the noise levels for Existing Conditions for sites influenced by traffic noise. All of the traffic sites are short-term (10-15 minutes) monitoring sites. Most of the peak period noise levels were modeled with TNM using traffic volumes developed for Existing Conditions. Noise levels for the other periods are based on monitored values.

Within a given area, noise levels varied with a site's distance from the highway noise source. For each site, noise levels for the weekday AM, Midday, and PM peaks were similar. The peak period L_{eq}s are approximately equivalent to an L_{dn}, and the approximate L_{dn} is indicated in the discussions below.

Table 7-1
Existing Noise Levels at Traffic Sites

Area	ID		Peak Periods			Off-Peak Periods		
		Location / Landmark	**AM**	**MID**	**PM**	**OP**	**LN**	**WE**
A	1	State police barracks	60.3	60.2	60.7	-	51.4	-
A	3	Playground	58.2	58.2	58.8	51.2	43.7	50.7
A	5	Golf Course	36.3	34.3	34.4	-	-	-
A	6	Greenbrier Avenue	64.0	63.4	62.6	-	-	-
A	7	Walnut Street	-	51.7	-	48.3	-	44.9
A	8	Grace Baptist Church	49.6	48.5	49.6	53.6	-	55.6
B	1	Rainelle Medical Center	61.9	62.4	60.6	-	57.3	-
B	2	Rainelle Elementary	62.0	61.8	60.4	-	-	-
C	1	North Sewell Street at Route 20/60	63.9	64.0	63.4	-	56.7	-
C	4	Cherry Street	52.4	51.8	50.6	-	-	-
C	5	Nicholas Street	55.9	51.5	52.4	-	-	-
D	1	Seventh Street at Main St.	67.8	68.6	67.3	-	58.0	-
E		Route 1 @ Route 60, Rupert	69.1	69.1	68.0	-	62.2	-
F		Route 60 at Route 20, Charmco	66.1	65.3	65.3	-	63.6	-
G		Route 20, Green Valley	64.7	67.3	65.7	-	68.1	-
H		Route 20, Quinwood	68.1	67.9	66.3	-	65.5	-
I		Route 20/60, Youth Park, Rainelle	59.3	59.8	58.3	-	55.7	-
J		Route 1, Anjean Mtn.	60.5	62.1	58.7	-	-	-
K		Donegan, Route 1 north of Anjean Mtn.	62.6	59.2	56.5			
L		Hillsboro, Route 219 north of Lewisburg	52.9	63.5	59.5			

Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
OP (Off Peak) – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
LN (Late Night) – Time frames after 10 pm, Monday through Thursday
WE (Weekend) – Time frames during Off-Peak periods on the weekend
Source: Potomac Hudson Engineering, Inc.

Homes in Area A are close to Route 20. The property line for A6 is only 7.5 feet from the roadway, and the peak hour L_{eq} ranges from 62.6 to 64.0 dBA. Due to vegetation and other site characteristics, the monitor could not be placed further back on the lot. The L_{dn} for this site was estimated to be approximately 63 dBA. At A1, the monitor could be placed about 15 feet from Route 20, and the L_{eq}s are about 3 decibels lower than for A6, ranging from 60.2 to 60.7 dBA. The late night L_{eq} of 51.4 dBA supports the rule of thumb that nighttime noise levels are about 10 dBA lower than daytime noise levels. The estimated L_{dn} at this site would be about 61 dBA.

The lower noise levels at Sites A3 through A6 and A8 are consistent with their distances from the roadway. Site A3 (playground) is about 30 feet from the roadway. Modeled noise levels for the golf course are very low because this site is so far from the highway that the modeled traffic noise falls below background levels. This site had a monitored L_{eq} of about 44 dBA for the Midday peak. The site on Walnut Street is a monitored noise level. Grace Baptist Church shows modeled noise levels that are about 8 dBA lower than monitored noise levels. This shows the influence of noise from the CSX rail facility across the street. It also explains the relatively small difference between peak (modeled) and off-peak (monitored) noise levels.

Homes in Area B are close to the highway, although site conditions generally allowed the noise monitor to be placed 15 to 25 feet from the roadway. Near the driveway to the Rainelle Medical Center, Route 20/60 divides, with some traffic headed south on Route 20 and the remainder headed west on Route 60. Thus, noise levels in the vicinity of the intersection are slightly higher, due to the higher traffic volume, than noise levels a little further west. The peak period L_{eq}s for both sites are in the low 60s, and the estimated L_{dn}s are estimated as approximately 62 dBA. A late night reading at Site B1 was only 3 to 5 dBA lower than a peak period L_{eq} due to traffic and vehicles idling at the service station on the corner, as well as voices from patrons at the service station.

The monitoring location for the home at Site C1 was approximately 12 feet from the roadway. This is a fairly busy intersection due to traffic in and out of the shopping center. The peak period L_{eq}s ranged from 63.4 to 64.0 dBA, and the estimated L_{dn} is approximately 64 dBA. Noise levels at Sites C4 and C5 are consistent with their distances from the highway. Sites on Cherry Street and Nicholas Street indicated that homes in this neighborhood are somewhat protected from highway noise through both distance and topography. This indicates that background noise levels (brooks, birds, trees) are also significant at this location. The late night noise level at Site C1 was 56.7 dBA.

The monitoring location at Site D1 is nearly 12 feet from the roadway. Peak period L_{eq}s ranged from 67.3 to 68.6 dBA, with a late night noise level of 58.0 dBA. The estimated L_{dn} for this site would be approximately 68 dBA.

Noise levels at Areas E through H are similar to those for Site D1 in downtown Rainelle. Monitoring locations in these areas are generally about 15 feet from the road. Route 20, from Green Valley to Route 60 in Charmco, shows little difference between peak period noise levels and late night noise levels. This is due to the relatively constant volume of truck traffic throughout the day. The 8% roadway grades on this section of Route 20 also contribute to traffic noise levels, as trucks must downshift when traveling uphill. Due to the closeness of the peak and late night noise levels, the L_{dn}s for these sites are expected to be higher than the values for the peak period L_{eq}s.

For the Western Greenbrier Youth Park (Area I), the modeled site is approximately 100 feet from the edge of the roadway due to the sloping close to the road. Peak period L_{eq}s were 58.3 to 59.8 dBA, with a late night monitored reading of 55.7 dBA. The late night reading is relatively high compared to the peak hour noise levels due to noise from frogs and insects. The L_{dn} at this site is estimated as approximately 59 dBA.

At Area J, the monitor was approximately 15 feet from the roadway. The comparatively low volumes at this site result in L_{eq}s of 58.7 to 62.1 dBA. No noise levels were monitored during a late-night period because very little traffic passes by the site after 7 pm. The estimated L_{dn} at this site would be approximately 62 dBA.

Area L was approximately 22 feet from the edge of the roadway. Only the peak PM period was monitored because the peak PM traffic volumes are very low. As a result, the TNM model would underpredict noise levels at this site because background noise levels would be greater than traffic noise. No noise levels were monitored during a late night period. The estimated L_{dn} at this site would be around 60 dBA.

7.2 POWER PLANT SITES

Table 7-2 shows the results of the consecutive 24-hour monitoring periods at six sites in the vicinity of the power plant site that were collected in January of 2005. The noise monitors logged L_{eq}s and other parameters at 15-minute intervals. This data was reduced by placing the data in a spreadsheet and calculating 24-hour L_{eq}s and L_{dn}s. Where possible the 24-hour period ran from midnight to midnight. However, inclement weather and machine malfunctions caused gaps in the data, and some 24-hour periods have a different time frame. This is also the reason why some sites have more days of information than other sites. Information for both weekday and weekend days are shown in Table 7-2.

Existing noise levels for the four short-term monitoring sites, C7 through C10, are shown in Table 7-2. They are affected by local traffic and background noise levels rather than highway noise. Local traffic may not correspond to commuter traffic patterns. Consequently, the noise levels for typical “peak” traffic periods are similar to the various off-peak periods. In some cases, the off-peak noise levels are higher than the “peak” periods. The L_{eq}s at these sites are generally in the upper 30s to upper 40s. Because the peak and off-peak readings are so close, the estimated L_{dn}s for these sites would be higher than the peak L_{eq}s, but well below 65.

Table 7-2
Existing Noise Levels at Short-Term Monitoring Sites in Vicinity of Power Plant

Area	ID	Location / Landmark	Peak Periods			Off-Peak Periods		
			AM	MID	PM	OP	LN	WE
C	7	Retirement Community	-	35.2	-	42.7	38.0	-
C	8	Nursing Home	-	47.0	-	46.4	45.3	48.2
C	9	ADA housing	-	38.9	-	41.6	43.5	40.2
C	10	Mobile Home Park	-	-	-	45.6	43.7	39.1

Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
OP (Off Peak) – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
LN (Late Night) – Time frames after 10 pm, Monday through Thursday
WE (Weekend) – Time frames during Off-Peak periods on the weekend
Source: Potomac Hudson Engineering, Inc.

As shown in Table 7-3, noise levels at LT1 through LT6 are low in comparison to readings observed in the downtown area and at sites influenced by roadway traffic. The minimum noise levels monitored range from 27.1 to 33.0 dBA. Although the maximum noise levels are substantially higher, ranging from 60.2 to 73.9 dBA, the calculated 24-hour L_{eq}s and L_{dn}s are still relatively low. The 24-hour L_{eq}s are generally in the mid 30s to mid 40s, while the L_{dn}s are in the upper 30s to low 50s. Weekends appear to be lower than weekdays. The L_{eq}s and L_{dn}s for these sites are approximately 20 dBA lower than the noise levels for the traffic sites. However, it is important to note that the long-term monitoring was conducted during the winter months, and that baseline noise levels would be expected to be higher from spring through fall when wildlife and insects (e.g., chirping birds and insects) would be active noise sources. It is also important to note that no rail traffic was observed over the weekend during this monitoring event, which is atypical for this area.

Table 7-3
Existing Conditions, Long-Term Monitoring Sites

Site ID	Location	Date	Time	Day	Min.	Max.	L_{eq} (24)	L_{dn}
LT1	Plant - Southeast Side	1/12/05	3:00p - 3:00p	Wed.-Thurs.	27.1	66.3	39.3	42.6
		1/15/05	12:00a - 12:00a	Saturday	29.1	68.2	37.0	41.4
		1/16/05	12:00a - 12:00a	Sunday	27.7	60.5	39.7	44.6
		1/17/05	12:00a - 12:00a	Monday	31.0	64.3	42.2	48.7
LT2	Plant - East Side	1/16/05	12:00a - 12:00a	Sunday	26.2	69.9	41.7	46.7
		1/17/05	12:00a - 12:00a	Monday	30.0	70.3	45.8	51.6
LT3	Plant - North Side	1/14/05	10:15p - 10:15p	Fri.-Sat.	28.0	66.9	38.8	41.9
		1/17/05	12:00a - 12:00a	Monday	31.5	71.6	41.2	46.5
LT4	Plant - West Side	1/15/05	12:00a - 12:00a	Saturday	30.4	64.9	42.0	46.1
		1/16/05	12:00a - 12:00a	Sunday	30.1	68.3	42.9	48.0
		1/17/05	12:00a - 12:00a	Monday	31.0	70.2	44.8	51.3
LT5	Eco-Park*	1/12/05	4:30p - 4:30p	Wed.-Thurs.	24.9	73.1	44.4	45.9
		1/15/05	12:00a - 12:00a	Saturday	24.0	60.9	36.5	39.6
		1/16/05	12:00a - 12:00a	Sunday	24.3	67.9	42.0	47.3
		1/17/05	12:00a - 12:00a	Monday	28.0	73.4	45.2	52.6
LT6	Pennsylvania Avenue	1/15/05	12:00a - 12:00a	Saturday	33.0	73.9	40.8	45.2
		1/16/05	12:00a - 12:00a	Sunday	31.2	65.4	43.5	49.2
		1/17/05	12:00a - 12:00a	Monday	36.0	70.5	47.4	54.0

Source: Potomac Hudson Engineering, Inc.
** No rail traffic observed over the weekend monitoring event*

8. NO BUILD CONDITIONS

8.1 TRAFFIC SITES

Table 8-1 shows the noise levels for No Build Conditions for the short-term monitoring sites. For the traffic sites, for the peak AM, Midday, and PM periods, the values were obtained by running the TNM model with traffic for No Build Conditions. This resulted in projected increases of 0.2 to 1.1 dBA. Because no traffic volumes were available for off-peak and late-night noise periods, these relative differences were added to the monitored values to derive noise levels for No Build Conditions during those periods. As can be seen from Table 8-1, the L_{eq}s and L_{dn}s for No Build Conditions are similar to those for Existing Conditions.

Table 8-1
No Build Conditions, Traffic Noise Levels (dBA)

Area	ID	Location / Landmark	Peak Periods			Off-Peak Periods		
			AM	MID	PM	OP	LN	WE
A	1	WV State Police Barracks	60.8	60.8	61.3	-	52.0	-
A	3	Playground	58.8	58.7	59.3	51.7	44.2	51.2
A	5	Golf Course	36.6	34.3	35.2	-	-	-
A	6	Greenbrier Avenue	64.0	64.0	62.6	-	-	-
A	7	Walnut Street	-	51.9	-	48.5	-	45.1
A	8	Grace Baptist Church	50.2	49.0	50.0	54.1	-	56.0
B	1	Rainelle Medical Center	62.4	62.9	61.2	-	57.9	-
B	2	Rainelle Elementary	62.2	62.0	60.6	-	-	-
C	1	North Sewell Street	64.2	64.4	63.9	-	57.2	-
C	4	Cherry Street	52.4	52.2	51.2	-	-	-
C	5	Nicholas Street	49.4	51.8	51.4	-	-	-
D	1	Seventh Street	68.5	69.1	67.7	-	58.4	-
E		Route1, Rupert	69.6	69.7	68.5	-	62.7	-
F		Route 60, Charmco	67.1	66.2	65.8	-	64.1	-
G		Route 20, Green Valley	65.4	67.9	66.2	-	68.6	-
H		Route 20, Quinwood	69.2	68.4	66.4	-	65.6	-
I		Route 20, Youth Park	59.8	60.4	58.8	-	56.2	-
J		Route 1, Anjean	61.3	62.7	59.3	-	-	-
K		CR 1, Donegan	63.6	63.4	60.3			
L		CR 219/CR 39, Hillsboro	53.6	64.2	59.5			

Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
OP (Off Peak) – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
LN (Late Night) – Time frames after 10 pm, Monday through Thursday
WE (Weekend) – Time frames during Off Peak periods on the weekend
Note: Monitored off-peak, late night, and weekend values for traffic sites(T) have been adjusted to reflect the relative increase in noise due to increases in background traffic for the peak periods.
Source: Potomac Hudson Engineering, Inc.

8.2 POWER PLANT SITES

For the areas near the proposed site, the No Action noise levels would be the same as the existing noise because no changes in background noise levels (e.g., local traffic, birds, insects, occasional freight train passbys, etc.) are anticipated. Therefore, the noise levels shown in Tables 7-2 and 7-3, which were obtained for the winter months, would be applicable to No Action conditions for the same season. During spring and summer, Existing and No Action noise levels would be higher due to higher background noise levels. However, for the purposes of preparing a worst case analysis, the relatively quiet winter time noise levels are the most appropriate.

9. BUILD CONDITIONS

9.1 TRAFFIC

9.1.1 Traffic Noise Sources

Employee Vehicles: It is expected that the power plant would employee 26 people. Twenty-four employees would staff the plant 7 days per week, 24 hours per day, with sixteen of them working the daytime shift from 8 am to 5 pm. Two additional employees would work at the power plant during the daytime shift from 8 am to 5 pm. Forty-four additional employees would work in the administration building, the ash byproduct manufacturing facilities, and other buildings during the day shift from Monday through Friday. Because all employees are expected to arrive or depart in their own vehicles, this is a total of 70 employees and 140 vehicular trips to or from the site, as shown in Table 9-1. For the purposes of determining peak hour traffic trips, only 62 employees (124 trips) were used because the 16 trips (8 arriving, 8 departing) during the late night shift change do not occur during a peak traffic hour. Half of the 124 daytime employee trips would occur during a peak AM or PM traffic period.

Table 9-1. Anticipated Number of Employees During the Dayshift

Facility	Day Shift Totals
Power Plant	18
Overhead – Power	7
General – Admin	3
Ash Byproducts (by a third party)*	10
Cementitious Structural Products*	14
Tilapia/Greenhouse*	10
TOTAL	**62**

**Not part of the Proposed Action; however, included to capture worst-case scenario for traffic analysis*

Source: WGC, 2004

Truck Trips: Truck trips would be associated with the power plant and the kiln and manufacturing facilities for the ash byproduct. Although the ash byproduct facilities are not a proposed component of the WGC project, ash byproduct associated vehicles were used in this noise analysis in anticipation of Eco Park tenants and to capture worst-case scenarios. Most of the truck traffic to transport materials to or from the site would occur during the daytime shift, Monday through Friday from 8 am to 5pm. The coal beneficiation/ash return trucks at the power plant would be 40-ton, 3-axle dump trailers that would operate from Monday through Friday from 8 am to 5 pm. Trucks delivering limestone or hauling other materials to or from the kiln and ash byproduct manufacturing buildings would be 20-ton, 2-axle dump trailers operating during the daytime shift only. Table 9-2 shows that 111 trucks would make round trips to the site from 8 am to 5 pm each weekday. For analysis purposes, a peak number of 15 one-way trips was used as a conservative worst case analysis for the TNM model.

Traffic volumes and work shifts modeled for the analysis in this report are based on one daytime shift, Monday through Friday. Deliveries may be interrupted in the morning and afternoon to accommodate school buses and children. Therefore, the peak traffic periods in the AM, Midday, and PM, which are not school arrival/departure times, were the periods modeled as the worst case for project-generated truck traffic.

Table 9-2 Worst-Case Trucking Requirements to Power Plant Facility during Operation

Material	Truck Size (ton)	Weekly Requirement (tons/wk)	Shift* Requirement (tons/shift)	# Trucks per Shift*	# Trips IN/hr	# Trips OUT/hr
Co-Production Facility						
Processed Fuel/Ash Return	40	12,600	2,520	66	8	8
Limestone (Boiler)	20	689	138	7	1	1
Cement Production Facility**/*Kiln Facilities*+						
Raw Material Delivery	20	163	33	1.6	---	
Alumina source	20	95	19	1	---	
Gypsum source	20	354	70	3.5	---	
Kiln Fuel	20	117	23	1.2	---	
Limestone++ (Kiln)	20	980	196	10	---	
Cement	20	700	140	7	---	
Cement Total				*24*	*3*	*3*

Note: Number of trucks shown reflects number of round trips per shift. To convert tons to metric tonnes, multiply value by 0.907.

**Shift means Eight-hr shift (Mon-Fri)*

***Associated kiln/cement production trucks were analyzed to capture worst-case scenarios in anticipation of planned cement-related deliveries.*

+ Source: Daily Requirements of Materials taken from Hazen's Flowstream Summary (CDR Book2 "04_02_02HazenFlowStreamSummary 12-22-04 CWK")

++ Source: Hazen (If WGC identifies pure CAO source, volume requirement is substantially reduced.)

9.1.2 Build Noise Levels at Traffic Sites

Traffic noise was modeled using the FHWA's TNM model. Two alternatives were modeled. Alternative 1 assumes that all coal refuse and pond fines would arrive from Anjean Mountain or Donegan. Under this alternative, traffic on Route 20 between Green Valley and Route 60 would be the same as for No Build Conditions except for additional employee vehicles. Traffic on Route 1 (Anjean Road) would increase, and traffic on route 60 between Rupert and Route 20 in Charmco would increase. Traffic on Route 20/60 between Charmco and the WGCP site would also increase.

Alternative 2 assumes the coal refuse materials would be taken from the Green Valley waste coal pile. Under this alternative, traffic on Anjean Road and on Route 60 between Rupert and Route 20 in Charmco would be the same as for No Build Conditions except for additional employee vehicles. However, traffic on Route 20 between Green Valley and Charmco would increase, along with traffic on Route 20/60 between Charmco and the power plant site.

Table 9-3 shows the noise levels at the traffic noise sites when Anjean Mountain is the source of coal refuse and pond fines. Peak hour noise levels at sites along the proposed truck routes would fall below the impact criterion of an incremental increase of 10 dBA. The highest increases in noise levels occur on Anjean Mountain. Peak period noise levels would increase by up to 6.3 dBA near the entrance to the coal mine on Anjean Mountain (Area J) and up to 5.7 dBA along CR1 to Donegan (Area K). This is the highest relative increase and it occurs because traffic volumes are low under No Action conditions.

Noise levels along WV 20 in Green Valley (Area G) and Quinwood (Area H) would show almost no increase under the Anjean alternative because project-generated traffic would include employee vehicles, but no trucks. Peak period L_{eq}s would continue to be in the 60s and 70s (see Section 4.1.4 for definition of the FHWA Noise Abatement Criteria).

From CR 1 in Rupert through downtown Rainelle (Areas B through I), the relative increases in noise during the peak traffic periods would fall below 3 dBA. Peak period L_{eq}s would continue to be in the 60s and 70s.

The receptor points along WV 20 from the Rainelle Medical Center south past the site entrance (Site IDs A1-A8) would experience noise level increases of up to 2.9 dBA depending on their distance from the highway. The location outside of the police barracks (A1) would have the highest increase in noise (2.9 dBA) because all of the project-generated traffic would converge at this intersection to turn into the roadway leading to the plant. Most of this traffic would also pass the intersection of Greenbrier Avenue and WV 20, where noise levels would increase by up to 2.4 dBA. South of the power plant entrance, at the playground (Site A3), noise levels would increase by up to 0.8 dBA. Although the golf course would experience a relative increase of up to 1.3 dBA, the modeled noise levels in the mid 30s still fall below ambient noise levels; thus the increase would not be noticeable.

Table 9-3
Traffic Noise Levels, Build Conditions, Anjean Mountain Coal Refuse Source

Area	ID	Location / Landmark	Peak Periods			Difference (Build – No Build)		
			AM	MID	PM	AM	MID	PM
A	1	WV State Police Station	63.7	63.7	63.9	2.9	2.9	2.6
A	3	Playground	59.5	59.5	60	0.7	0.8	0.7
A	5	Golf Course	37.4	35.9	36.3	1.1	1.3	1.1
A	6	Greenbrier Avenue	65.9	65.8	65	1.9	1.8	2.4
A	7	Walnut Street	Interior location surrounded by homes					
A	8	Grace Baptist Church	50.4	49.5	50.2	0.2	0.5	0.2
B	1	Rainelle Medical Center	63.1	63.4	62.1	0.7	0.5	0.9
B	2	Rainelle Elementary	62.5	62.3	61.1	0.3	0.3	0.5
C	1	North Sewell Street	65.5	65.6	65.2	1.3	1.2	1.3
C	4	Cherry Street	53.7	53.5	52.9	1.3	1.4	1.7
C	5	Nicholas Street	49.8	52	51.6	0.4	0.2	0.2
D	1	Seventh Street	69.5	70	68.8	1	0.9	1.1
E		Route1, Rupert	70.4	70.5	69.5	0.8	0.8	1
F		Route 60, Charmco	67.8	67.1	66.7	0.7	0.9	0.9
G		Route 20, Green Valley	65.4	67.9	66.2	0	0	0
H		Route 20, Quinwood	69.2	68.4	66.4	0	0.0	0
I		Route 20, Youth Park	61	61.4	60.3	1.2	1	1.5
J		Route 1, Anjean	66.1	66.6	65.6	4.8	3.9	6.3
K		CR 1, Donegan	66.5	67.1	66.0	2.9	3.7	5.7
L		CR 219 at CR 39 in Hillsboro	53.6	64.2	59.5	0	0	0.0

Source: Potomac Hudson Engineering, Inc., May 26, 2006

Table 9-4 shows the relative noise level increases when Green Valley is the source of coal refuse and pond fines. Under these conditions, the noise levels on Anjean Mountain and Donegan (Areas J and K) would show almost no increase while the noise levels in Green Valley (Area G) and Quinwood (Area H) would increase by up to 1.7 dBA. Although the additional number of trucks passing these sites on WV 20 is the same as for CR 1 on Anjean Mountain, the relative noise level increase is lower due to the volume of trucks on Route 20 under No Action Conditions. Noise levels on these two roadways constitute the only difference in noise levels between the two scenarios. Relative increases in noise levels at the other sites are the same because the traffic under Build Conditions is the same. The noise levels for the Mill Point Quarry in Hillsboro would increase only if that source is used for limestone. Otherwise noise levels would be the same as No Action alternative.

Short-term peak noise levels from coal trucks accelerating or decelerating would be similar to noise levels from the coal and lumber trucks currently operating on the roadways. Because a higher number of trucks would be on the roads under Build Conditions, these peak truck noises would occur more frequently. An hourly average of 11 (daytime) to 17 (nighttime) additional truck passbys would occur under Build Conditions. Short-term peak noise levels from the additional trucks would be greatest at hills and intersections where heavy trucks must accelerate, decelerate, or brake, as well as at locations where trucks hit bumps or potholes in the roadway surface.

Table 9-4
Traffic Noise Levels, Build conditions, Green Valley Coal Refuse Source

Short-Term Noise Monitoring Locations (L_{eq})									
Area	**ID**	**Location / Landmark**	**Type**	**Peak Periods**			**Difference (Build – No Build)**		
			T/P	**AM**	**MID**	**PM**	**AM**	**MID**	**PM**
A	1	WV State Police Barracks	T	63.7	63.7	63.9	2.9	2.9	2.6
A	3	Playground	T	59.5	59.5	60	0.7	0.8	0.7
A	5	Golf Course*	T	37.4	35.9	36.3	0.8	1.3	1.1
A	6	Greenbrier Avenue	T	65.9	65.8	65	1.9	1.8	2.4
A	7	Walnut Street	T	Interior location surrounded by buildings					
A	8	Grace Baptist Church	T	50.4	49.5	50.2	0.2	0.5	0.2
B	1	Rainelle Medical Center	T	63.1	63.4	62.1	0.7	0.5	0.9
B	2	Rainelle Elementary	T	62.5	62.3	61.1	0.3	0.3	0.5
C	1	North Sewell Street	T	65.6	65.6	65.2	1.4	1.2	1.3
C	4	Cherry Street	T	53.7	53.5	52.9	1.4	1.3	1.7
C	5	Nicholas Street	T	49.8	52	51.6	0.4	0.2	0.2
D	1	Seventh Street	T	69.5	70	68.8	1	0.9	1.1
E		Route1, Rupert	T	69.7	69.8	68.7	0.1	0.1	0.2
F		Route 60, Charmco	T	67.3	66.5	66.1	0.2	0.3	0.3
G		Route 20, Green Valley	T	66.8	68.8	67.5	1.4	0.9	1.3
H		Route 20, Quinwood	T	70.2	69.6	68.1	1	1.2	1.7
I		Route 20, Youth Park	T	61	61.4	60.3	1.2	1	1.5
J		Route 1, Anjean	T	61.3	62.7	59.3	0	0	0
K		CR 1, Donegan	T	63.6	63.4	60.3	0	0	0
L		CR 219 at CR 39 in Hillsboro	T	53.6	64.2	59.5	0	0	0.0

*Modeled noise levels are below background noise levels; N/A = not available
Source: Potomac Hudson Engineering, Inc., May 26, 2006

9.1.3 Late Night Noise

Late-night noise levels are not a source of concern under Build Conditions because the trucks would not travel along the routes between the sources and the power plant during these hours. However, trucks may travel from the coal refuse sources to nearby beneficiation plants. Because late-night noise levels are generally much lower than daytime noise levels due to the lower traffic volumes, the potential for the project-generated trucks to cause a noise impact at residences near the coal refuse sources may need evaluation at a future date.

9.2 WGC CO-PRODUCTION FACILITY

9.2.1 Site Layout

Figure 9-1 depicts the layout of buildings and yard activities used in modeling noise levels for the power plant, which would be on a plateau approximately 20 feet higher than the surrounding terrain. The fence delineating the property boundary also is evident on Figure 9-1. This fence line includes the planned acquisition of a residential property east of the site. The power plant would be accessed by Tom Raine Drive from Route 20 to the west. Vehicles would enter at the Guard and Scale House. Figure 9-2 shows the locations of the on-site equipment and activities used in modeling the noise levels with the CADNA model. The information in Figures 9-1 and 9-2 is slightly different from the information presented in the EIS sections, which show a more recent site plan. However, the modeled results in this technical report constitute a worst case for modeling purposes. Preliminary CADNA runs that included some of the major updates to the site plan showed that noise levels at nearby receptor points would be substantially similar to the results in this technical report.

9.2.2 Administration/Warehouse Building

No significant sources of noise are located in the vicinity of the administration/warehouse building, which would be heated with electricity. Employee parking and the administration/warehouse building would be on the western side of the site, close to the access gate and truck scale. This area is separated from the rest of the site by a triangular-shaped grassy knoll.

9.2.3 Motor Vehicles

The hourly volume of employee vehicles would be the same as described in Table 9-1 under the discussion of traffic noise. For the power plant, eight employees would enter and eight would exit during a peak AM, PM, or late night period. For the administration building, as well as the ash byproduct manufacturing facility and greenhouse/tilapia farm that may be located in the Eco Park to the west, an additional 42 employees would arrive during the peak AM period and depart during the peak PM period. As previously noted, traffic noise was not included in the CADNA modeling. The volume of employee vehicles at the site is not considered to be a source of concern for surrounding residents. This traffic was included in the modeling of highway noise as previously discussed, but was not included in the CADNA modeling.

9.2.4 Materials Handling and Truck Deliveries

Materials handling for the power plant would occur on the southern and western portions of the site, which are the most distant from nearby residences. Although the beneficiation plants would reduce the number of truck trips to the power plant, this analysis is based on previous plans, in which delivery trucks with coal refuse or limestone proceed to the one-day coal refuse storage pile or the 3.5-day limestone storage pile. Trucks with wood chips for the ash byproduct manufacturing facility would make their deliveries at the northern end of the site. The hourly volume of trucks would be the same as described in Tables 9-1 and 9-2 under the discussion of traffic noise. Beneficiation plant trucks would be on site for approximately 10 minutes each, and limestone trucks for approximately 5 minutes each. The hours for truck deliveries would be limited to daytime hours. These trucks were not included in the CADNA modeling due to their small size (relative to the operations buildings), intermittent nature, and distance

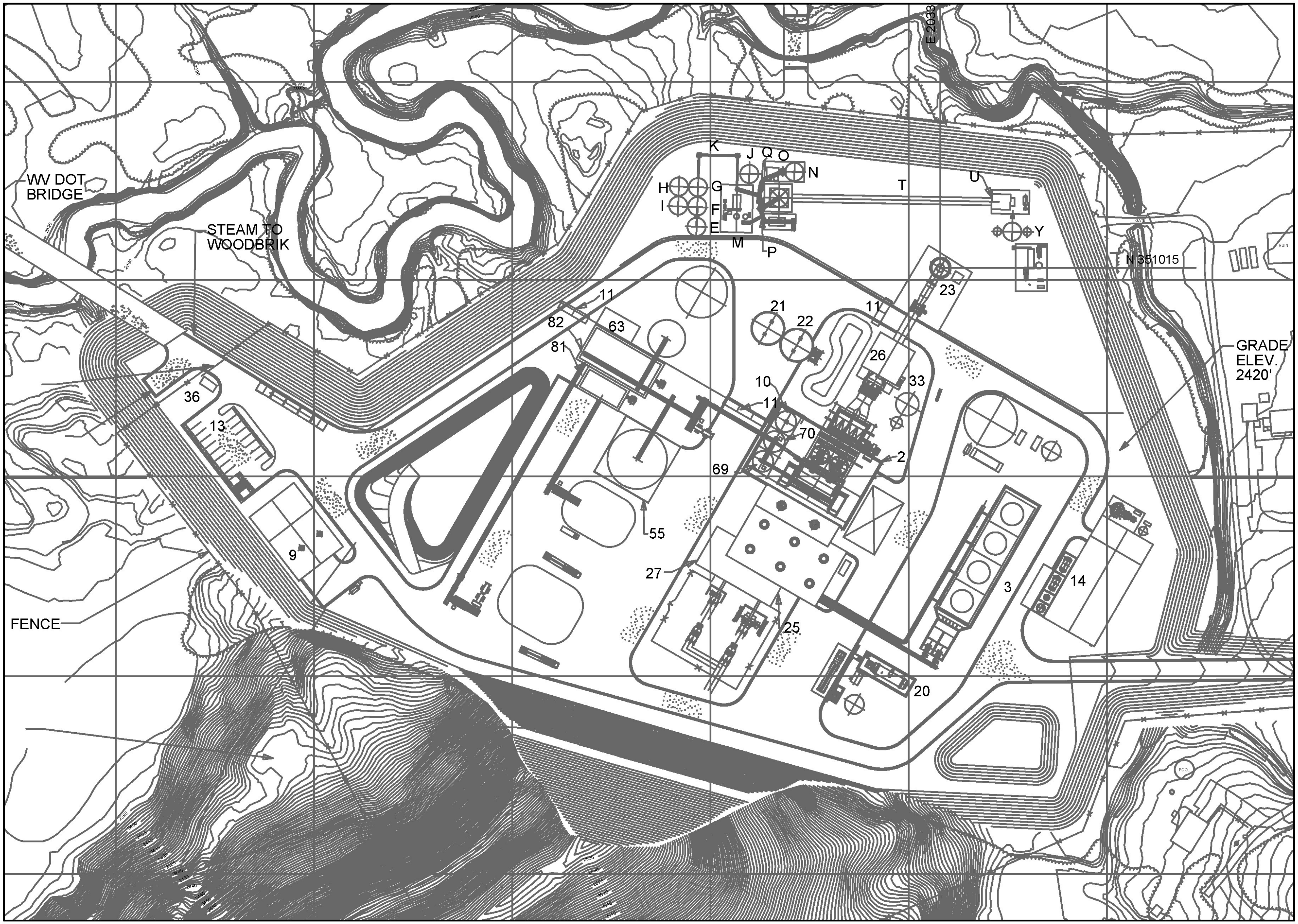


Figure 9-1
WGC Site Building Layout

Source: Parsons E&C DWG No. WGC1-1-SK-111-002-006 Rev F and WGC1-1-SK-047-002-001 Rev B

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Legend for Figure 9-1: Site Buildings Layout	
Building or Area ID Number	**Building or Area Use**
1	Steam Turbine Generator Building
2	Boiler Building
3	Cooling Tower
9	Admin/Warehouse/Maintenance
10	Limestone Day Silo
11	Utility Bridge
13	Parking
14	Water Treatment Building
20	Ammonia Storage
21	Fly Ash Silo
22	Bottom Ash Silo
23	Cems Enclosure
25	Electric Room
26	Baghouse
27	Control Complex
33	Lime Unloading and Storage Silo
36	Guard and Scale House
55	Prepared Fuel Pile Storage Building
63	Coal Prep System Byproduct Beneficiation Facility
69	Coal Day Silo A
70	Coal Day Silo B
81	Limestone Preparation Building
82	Coal Preparation Building
E	Limestone Bin 1
F	Limestone Bin 2
G	Bottom Ash Bin
H	Synthetic Gypsum Slurry Tank
I	Fly Ash Bin
J	Homogenizing Silo
K	Peg Mill
M	Raw Mill
N	Raw Coal Bin
O	Coal Mill
P	Preheater Conditioning Tower
Q	Preheater Fan
T	Rotary Kiln
U	Clinker Cooler
Y	Off Spec. Clinker Bin
a.	Finish Mill

Source: Parsons, April 2005

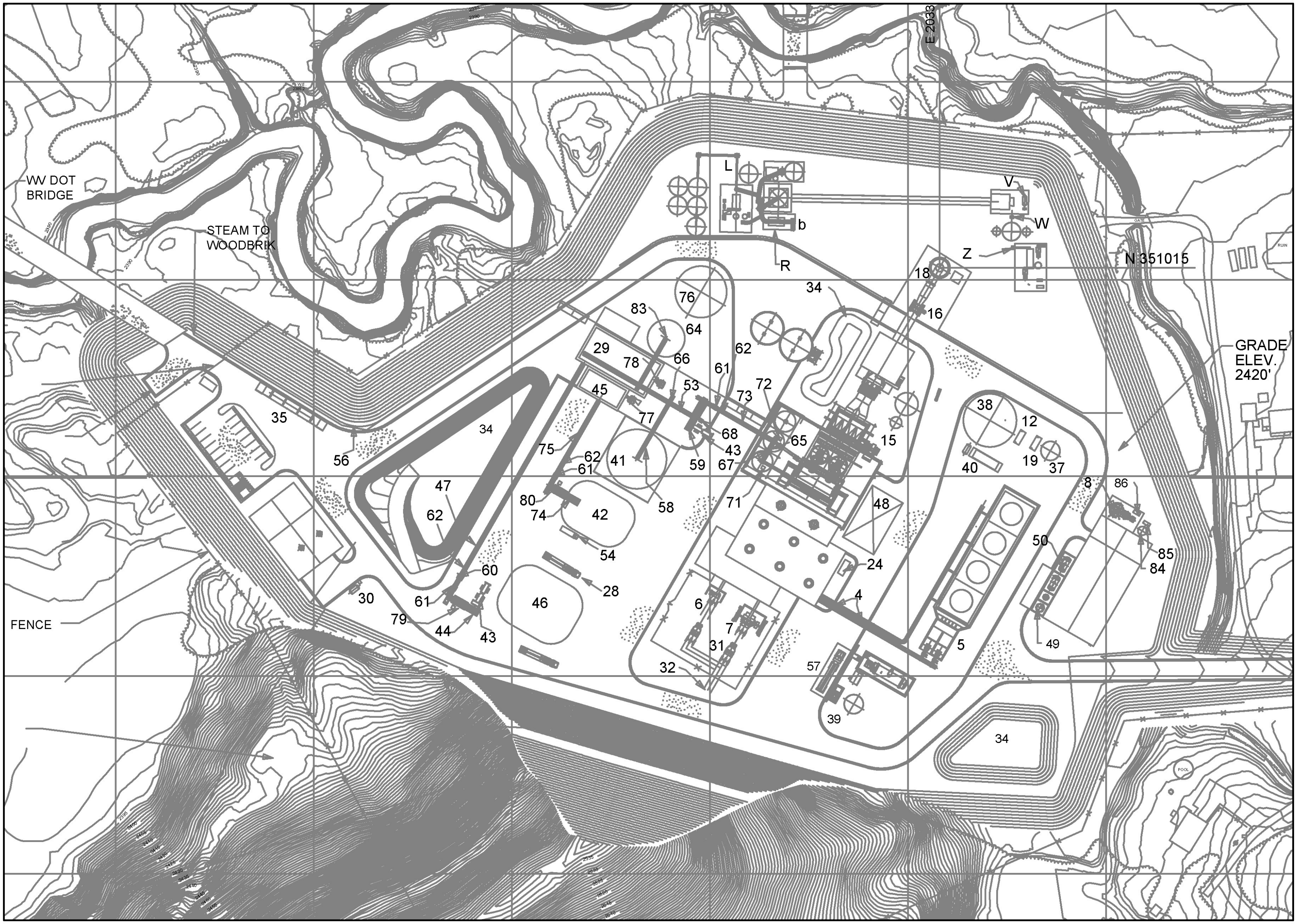

Figure 9-2

WGC Site Equipment Layout

Source: Parsons E&C DWG No. WGC1-1-SK-111-002-006 Rev F and WGC1-1-SK-047-002-001 Rev B

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Legend for Figure 9-2: Site Equipment Layout			
Equipment ID Number	**Description**	**Equipment ID Number**	**Description**
4	Circulating Water Piping	53	Fuel Product Collecting Conveyer Tripper
5	Circulating Water pumps	54	Limestone Truck
6	Unit Auxiliary Transformer	56	Steam Pipe to Woodbrik Facility
7	Step-up Transformer	57	Ammonia/Fuel oil Truck Unloading
8	Clarifier	58	Prepared Fuel Stacking Conveyer
12	Clarified Water Supply Pumps	59	Prepared Fuel Loading and Transfer w/ Hopper & Grizzly
15	Primary Air Fan	60	Metal Detector
16	ID Fan	61	Magnetic Separator
17	Not Used	62	Belt Scale
18	Stack	64	Coal Prep System Byproduct Pile
19	Cycle Make-up Pumps	65	Coal Day Silo Feed Conv Dust Collector
24	Oil Water Separator	66	Prepared Fuel Stacking Conveyer Dust Suppression System
28	Coal Truck	67	Coal Day Silo Distribution Conveyer
29	Coal Preparation	68	Prepared Fuel Loading & Transfer Feeder Dust Suppression System
30	Diesel Refueling Area	71	Coal Day Silo A Dust Collector
31	Switchyard	72	Coal Day Silo B Dust Collector
32	69kv Line	73	Coal Day Silo Feed Conveyor
34	Site Drainage Basin	74	Limestone Reclaim Feeder
35	Truck Scale	75	Limestone Reclaim Conveyor
37	Demin/Condensate tank (100,000 Gal)	76	Thickener
38	Clarified/Fire Water Tank (1,000,000 Gal)	77	Limestone Prep System Dust Collection System
39	Fuel Oil Tank (100,000 Gal)	78	Coal Prep System Dust Collection System
40	Service/Fire Water Pump Hose	79	Coal Loading Feeder Dust Suppression System
41	Prepared Fuel Pile (12 hours)	80	Limestone Reclaim Feeder Dust Suppression System
42	Limestone Pile (3.5 days)	83	Coal Preparation System Byproduct Conveyor (Reversible)
43	980G Wheel Loader	84	Raw Water Storage Tank
44	Coal Loading feeder w/Hopper & Grizzly	85	Raw Water Forwarding Pumps
45	Limestone Preparation System	86	Calcified Water Forwarding Pumps
46	Coal Refuse Storage Pile (1 day)	L	Raw Materials Belt Conveyor
47	Coal Prep Plant Feed Conveyer	R	Main Fabric Filter
48	Crane Setting Area	V	Clinker Cooler Fabric Filter
49	Cooling Tower Chemical Feed Area	W	Bucket Elevator
50	Acid Storage Tank and Feed Skid	X	Clinker Bin
51	Fly Ash Piping (Later)	Z	Bucket Elevator
52	Bottom Ash Piping (Later)	b.	Kiln Flue Gas Duct

Source: Parsons E C, April 2005.

from sensitive receptors. The volume of trucks at the site, based on information available at the time of this report, is not considered to be a source of concern for surrounding residents.

Limited information is available on the potential impacts from back-up alarms. These sounds are pure tones in the 1350 or 4000-5000 range, and they would attenuate quickly with distance. Additional modeling is planned to determine whether they would create noise impacts to the surrounding community. No information is available on noise spectra associated with trucks dumping materials at this site. Additional noise monitoring and modeling are needed to further evaluate this noise source.

Conveyor belts are not considered to be a significant source of noise because they typically do not cause noise problems unless the rollers or belts are squeaking; which is expected to be prevented with proper maintenance. However, the motors for the conveyors were included in the modeling for individual buildings.

9.2.5 Power Plant and Ash Byproduct Buildings

A review of the processes and equipment associated with the worst-case site plan for the proposed power plant indicated that the following buildings and equipment could be a significant source of increased noise levels at the site boundary due to the configuration of fans, conveyor motors, crushers, pumps, and compressors within the buildings:

Coal preparation building. The coal preparation plant is included in the CADNA modeling, although its functions are currently planned to occur at the off-site beneficiation plants. Originally, coal refuse would have been screened, crushed, and dewatered in the coal preparation building. The processed coal, which would be ready for burning, would then be transported to the CFB coal day silos or to a fuel storage pile. The CADNA modeling for this report includes simultaneous use of both of the coal crushers in the building, although the likelihood is that only one at a time would be in use.

Limestone preparation building. Limestone would be dried and sized to meet the limestone sizing specifications in the limestone preparation building. The prepared limestone would then be transported pneumatically to the CFB limestone day bin and the kiln limestone day bin. The building can process up to 55 tons of limestone per hour. Both of the limestone crushers were modeled even though they are not expected to be in use simultaneously. The pressure blower was also included in the CADNA model.

Boiler building. Coal and limestone from the day silos and storage pile would be burned in a fluidized bed combustor (CFB) in the boiler building to create heat for steam for the steam turbine generator. Residual ash would be removed, and some of it would be used in the rotary kiln for the Woodbrik process. The CADNA modeling for this building includes conveyor motors, compressors, fluidized air blowers, and building roof fans. An induced draft fan would be connected to the boiler's stack vent to help exhaust gases from combustion. This fan would be located outdoors, adjacent to the boiler building, and it also was included in the CADNA model.

A forced draft fan would operate to ensure sufficient air supply for the coal combustion in the boiler building. Frequently, forced draft fans are placed outdoors. Due to the fan's high noise levels and the power plant's proximity to residential areas, a building to reduce the level of noise reaching the site boundary would enclose the forced draft fan. Both the forced draft and induced draft fans were modeled with silencers and acoustic lagging because these noise attenuation measures would be needed to achieve OSHA standards for employees.

Steam turbine generator building (STG). In this building, high-pressure steam would turn the blades of the turbine to create electric energy. At the end of the turbine, the steam enters a condenser to recapture the water. Key equipment used to model the noise from the STG includes pumps, air compressors, the steam turbine generator itself, and building roof fans. The step-up transformer located in the yard adjacent to the STG also was modeled.

Cooling towers. The purpose of the cooling tower is to reduce the temperature of the steam in the condenser at the end of the STG. Liquid droplets that are entrained in the steam would be carried out of the tower, where they will evaporate. A cooling tower with four cooling tower cells was included in the modeling. Noise sources in the CADNA model also included the circulating water pumps, cooling tower fans, and cooling tower inlet. A splash attenuation and inlet barrier wall to reduce noise levels were included in the CADNA modeling for the cooling towers.

Buildings associated with the ash byproduct manufacturing process that could be a significant source of noise under the worst-case site plan include:

Coal mill. Approximately 55 tons per hour of coal from the coal preparation building would be further pulverized for use as fuel for the kiln. The pulverizer is the primary source of noise from the mill.

Clinker cooler building. Raw meal is fed to a long, dry kiln where limestone is decomposed and the various mineral components chemically combine to form the desired new compounds, called clinker. The hot clinker formed in the kiln burning zone passes into a grate-type air-swept cooler. The air cools the clinker from about 2,300^{o} F to 250^{o} F. Noise from the fan and other equipment were included in the CADNA modeling.

Finish mill. The cooled clinker is conveyed to a 210-ton storage bin, then conveyed to an air-swept ball mill for grinding. The grinding mill product is collected and pneumatically conveyed to the Woodbrik manufacturing plant, where it is stored in a 1,000-ton capacity bin. Noise from the kiln equipment was included in the CADNA modeling.

9.2.6 CADNA Modeling

For each of the noise sources, information on the equipment noise, by octave band, was obtained from industry specifications provided by vendors and is typical of the equipment that would be installed for the operations. For sources where vendor data was not provided, available algorithms were used to estimate the spectral data. As specific vendor specifications have not yet been developed, many vendor-specific noise control measures have not yet been identified or incorporated into the model. Buildings were assumed to have metal walls with insulation. The forced draft and induced draft fans, as well as the cooling towers, were modeled with representative noise attenuation measures as previously described.

Table 9-5 presents the results of the CADNA modeling for the worst-case base plant (i.e., without additional mitigation measures). The model predicts daytime noise levels ranging from 55.1 to 64.9 dBA, which results in L_{dn}s that range from 61.9 to 71.3 dBA. Thus, without further mitigation, all sites would be expected to exceed the impact criterion of a 60 dBA L_{dn}. The highest noise levels are at the property line north of the site (LT3).

Table 9-5
Build Noise Levels at Base Plant Power Plant Sites

Receptor Points		Modeled Results (dBA)			Build L_{dn}- 60 L_{dn}
Site ID	**Location**	**Daytime**	**Nighttime**	**L_{dn}**	
LT1	Plant - Southeast Side	57.2	67.2	63.6	3.6
LT2	Plant - East Side	Not applicable, property to be acquired			
LT3	Plant - North Side	64.9	74.9	71.3	11.3
LT4	Plant - West Side	56.9	66.9	63.3	3.3
LT5	Eco-Park*	55.1	65.1	61.5	1.5
LT6	Pennsylvania Avenue	55.5	64.5	61.9	1.9
C7	Retirement Community	61.9	71.9	68.3	8.3
C8	Nursing Home	55.5	65.5	61.9	1.9
C9	ADA housing	56.0	66.0	62.4	2.4
C10	Mobile Home Park	55.2	65.2	61.6	1.6

Source: Potomac Hudson Engineering, Inc., October 7, 2005

CADNA provides information on the contributions of each source to the noise levels at a given receptor point. To identify the sources of noise that need mitigation, the contributing sources for each receptor point were ranked from highest to lowest noise level. The top three sources for each receptor point are presented in Table 9-6. The base plant modeling does not include the full range of potential noise attenuation and mitigation measures that may be incorporated in the plant design, because the detailed specifications and equipment vendors on which these measures are dependent have not yet been finalized. Primary noise contributors identified in the model are shown in Table 9-6. Although other types of equipment contributed lesser amounts of noise at each site, they could still contribute to an exceedance of the 60 dBA L_{dn} due to the number of such sources. Approximately 65 sources of noise were modeled at the power plant site. To achieve an L_{dn} of 60 dBA, the daytime noise levels from each individual source must be well below 60.0 dBA at the property line. For example, if one source creates a noise level of 50 dBA at a given receptor point, then a maximum of 10 sources may have a noise level of 40 dBA, an additional 30 may have a noise level of 30 dBA, and the remaining 24 must have a noise level of 20 dBA or lower to maintain an L_{dn} of 60 dBA at the receptor point.

9.2.7 System Startup and Maintenance

During facility startup, the steam must be conditioned. This means that it must be free of minerals or other impurities that could plug the lines or cause deposition on the turbine blades. Typically, the operators start up the boiler, but have the steam bypass the turbine and enter the condenser. This is done repeatedly until the quality of the steam is suitable for the turbine. If a line or valve becomes plugged during this process, the pressure relief (blow-off) can generate notable amounts of noise. To avoid noise impacts, temporary silencers can be installed on all drain lines and vents. These pieces of equipment are typically removed after the steam has been conditioned. Another means of minimizing impacts during this process is to perform venting, flushing, and cleaning during daytime hours. However, some steam must be generated during the overnight period so that the equipment can be brought into operation the next day.

Table 9-67
Build Conditions, Power Plant Sites

Receptor Points		Daytime L_{dn}	Highest Contributing Sources of Noise (dBA)		
Site ID	**Location**		**1**	**2**	**3**
LT1	Plant - Southeast Side	63.6	49.5 DE aerator	48.4 STG – east	48.0 STG - east
LT2	Plant - East Side	Not applicable. Property to be acquired.			
LT3	Plant - North Side	71.3	58.2 ID fan	56.8 coal mill – west	56.8 coal mill - east
LT4	Plant - West Side	63.3	50.4 coal conveyor	50.4 clinker cooler – north	47.6 limestone prep – south
LT5	Eco-Park	61.5	48.0 limestone prep – east	44.5 limestone prep – south	44.4 coal/limestone conveyor
LT6	Pennsylvania Avenue	61.9	49.3 ID fan	44.8 FD – east	43.9 raw material conveyor
C7	Retirement Community	68.3	59.6 raw material conveyor	56.7 ID fan	46.2 FD – east
C8	Nursing Home	61.9	51.6 raw material conveyor	50.5 ID fan	42.5 FD – east
C9	ADA housing	62.4	50.2 ID fan	48.7 raw material conveyor	47.3 FD – east
C10	Mobile Home Park	61.6	51.1 ID fan	47.4 coal/limestone conveyor	42.2 coal prep - north

Notes: FD = forced draft building east, west, or north wall
FM= finish mill east, west, or north wall
STG= steam turbine generator building east, west, or south wall
Source: Potomac Hudson Engineering, Inc., October 7, 2005

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10. CONSTRUCTION NOISE AND BLASTING

10.1 CONSTRUCTION EQUIPMENT NOISE

Table 10-1 presents typical noise levels due to various types of construction equipment. Noise levels may temporarily increase due to construction-related traffic and on-site use of construction equipment. Construction is regulated by EPA noise emission standards for construction equipment. The duration and magnitude of any impacts will depend on the type of equipment in use and the particular phase of construction. Potential impacts from construction activities can be minimized by using properly maintained and muffled equipment. Coordination with local officials in order to minimize or alert residents in advance to especially noisy activities is also recommended. In addition, construction materials should be handled and transported in a manner that avoids unnecessary noise. Adherence to these procedures should be specified in the bid documents.

Table 10-1
Typical Noise Levels For Various Types Of Construction Equipment

Type of Equipment	Noise Level (dBA) at 50 Feet	Type of Equipment	Noise Level (dBA) at 50 Feet
Clearing		**Grading and Compacting**	
Bulldozer	80	Grader	80-93
Front end Loader	77-84	Roller	73-75
Dump Truck	83-94	**Paving**	
Jackhammer	81-98	Paver	86-88
Crane with ball	75-87	Truck	83-94
Excavation and Earth Moving		Tamper	74-77
Bulldozer	80	**Landscaping and Clean-Up**	
Backhoe	72-93	Bulldozer	80
Front end loader	73-84	Backhoe	72-93
Dump truck	83-94	Truck	83-94
Jackhammer	81-98	Front end loader	72-84
Scraper	80-93	Dump truck	83-94
		Paver	86-88
Structure Construction			
Crane	75-87	Pneumatic Tools	81-98
Welding generator	71-82	Bulldozer	80
Concrete mixer	74-88	Pile Driver	91-105
Concrete pump	81-84	Front end loader	72-84
Concrete vibrator	76	Dump truck	83-94
Cement and dump trucks	83-94	Paver	86-88
Air compressor	74-84		

Source: U.S. Environmental Protection Agency, "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances," NJID 300.1, December 31, 1971.

Note: Noise levels from equipment can vary according to the engine size. Thus, the table may show a different range of typical noise levels for some types of equipment during different construction phases,

10.2 CONSTRUCTION BLASTING

10.2.1 Need for Blasting

Some blasting may be required to loosen rock as part of site preparation activities. Blasting would occur on an intermittent basis over a relatively short period for the construction phase.

10.2.2 Fundamentals of Blasting and Vibration

Blasting and rock drilling can produce noise levels greater than 90 dBA at the source. Rock blasting includes planning, execution, and closure phases. As part of the planning for construction work, specifications are usually developed to ensure blasting is done safely and in conformance with the requirements of the project. Before blasting begins in new areas, it is important to define how blasting might impact neighbors, animals, structures, utilities and the environment in general.

Ground vibration is commonly viewed as the major concern for off-site damage resulting from blasting (ODOT, 2005). The measurement of ground vibration is Peak Particle Velocity (PPV), which is the maximum speed (measured in inches/second or mm/second) at which a particle in the ground is moving relative to its inactive state.

Extensive research has been conducted over the last 40 years by the U.S. Bureau of Mines and the Office of Surface Mining (OSM) to develop acceptable vibration standards, vibration damage criteria, and techniques to predict and control blast vibrations that greatly reduce the risk of off-site impacts from blasting.

The principal factors that affect ground vibration levels at a given point are:

- Weight of the explosive fired per delay period
- Distance from blast to point of concern (house, well, etc.)
- Blast configuration (existence of a free face, trench, confined area, etc.)
- Geology (sites with a thick layer of soil have been known to produce vibrations 10 times as great as locations with a thin layer of soil over rock).

The first two factors are the most influential to ground vibration. The distance from the blast to the point of concern cannot be controlled by the blasting contractor, but the weight of the explosives fired per delay can be.

10.2.3 Blasting Legislation

Federal Guidelines

The OSM initially found that if PPV were limited to 1 inch/second, then 95% of the damage to (surrounding) houses and structures would be prevented. After more recent research, the PPV limit is now 0.5 inches/second to avoid off-site damage. A PPV of 0.5 is generally equivalent to the vibration caused by a loaded truck or bus passing by 50 to 100 feet away. As a general rule, a person will begin to feel blast vibrations at levels as low as 0.02 inches/second. This is well below the level at which research has shown that damage may occur.

State Legislation

The WVDEP's Office of Explosives and Blasting (OEB) is responsible for regulating surface mine blasting operations. Blasting activities are required to comply with the Citizens Guide to Blasting published by WVDEP in March 2002. Some of the main provisions of the OEB regulations are:

- Blasting may not be conducted with 300 feet of a dwelling unless permission is granted by the owner of the structure.
- Blasting may not be conducted within 300 feet of a school, church, or hospital and not within 100 feet of a cemetery.
- The blaster will define and control access to all areas (blast area) where flyrock may injure people.
- A pre-blast survey must be offered prior to initiation of blasting. This includes contacting owners and/or occupants of dwellings within one-half (0.5) mile of the permitted area.
- Operators that will detonate 5 pounds or more of explosives at any given time must publish a blasting schedule in a newspaper of general circulation in all the counties of the proposed blasting area. Copies of the schedule shall be distributed by certified mail to local governments, public utilities and each resident within 0.5 miles of the permit area.
- Unless otherwise specified by the DEP, detonation blasts may only occur between the hours of sunrise and sunset, Monday through Saturday.

Because the proposed blasting does not relate to mining, the OEB's regulations do not strictly apply.

Local Legislation

A zoning ordinance in the city of Lewisburg, WV, has provisions covering blasting operations (Section 55). (Lewisburg, 2005) However, neither Greenbrier County nor Rainelle have ordinances that cover blasting activities. Under the Lewisburg ordinance, blasting shall be considered in compliance if the following measures are followed:

1. The weight in pounds of explosive charge detonated at any one time shall conform with the following scaled distance formula: $W = (D/50)^2$. Where W = weight in pounds of explosive detonated at any one instant time, D = distance in feet from the nearest point of blast to nearest residence, building or structure: that explosive charges shall be considered to be detonated at one time if their detonation occurs within eight milliseconds of each other.

2. Where blast size would be exceeded under Subdivision (1) of this ordinance, blast shall be detonated by the use of delay detonators to provide detonation times separated by nine milliseconds or more for each of the blasts complying with the scaled distance of the formula.

3. A plan of each blasting operations' methods for compliance with this section (blast delay design) for typical blast which shall be adhered to in all blasting within the City of Lewisburg, shall be submitted to the City of Lewisburg with the application for a permit. It shall be accepted if it meets the scaled distance formula established in Subdivision (1) of this ordinance.

4. Records of each blast shall be kept in a log to be maintained for at least 3 years, which will show for each blast other than secondary (boulder breaking) blasts the following information:
    - date and time of blast,

- number of holes,
- typical explosive weight per delay,
- total explosives and blast at any one time,
- number of delays used,
- weather conditions, and
- signature of operator/employee in charge of the blast.

10.2.4 Evaluation Criteria

The Proposed Action or an alternative may have a significant impact from blasting and vibration under any one of the following conditions:

- Conflict with a jurisdictional noise ordinance
- Cause a blasting PPV greater than 0.5 inches/second at off-site structures
- Cause an airblast in excess of 133 dB

10.2.5 Predictive Modeling

Potential blasting impacts are discussed qualitatively in this document because no details of the blasting plans are available at this time. For informational purposes, the predictive modeling techniques are discussed below.

The *Scaled Distance Equation* method is a mathematical equation, which allows an operator to prove compliance with the vibration limits without using a seismograph. To determine the weight of explosives that can be detonated without off-site damage, the following formula is used that relates PPV to distance and weight of explosives.

$$\mathbf{PPV = k * (d / \sqrt{w})^{a}}$$

where **k** and **a** are constants that vary depending on site conditions. Ideally, values for **k** and **a** are generally derived from blast vibration monitoring at a site, and define a line that represents a relationship between PPV and the weight of explosives for those conditions. In the absence of vibration monitoring from previous shots in the quarry and to take into account variations in geologic conditions and blast patterns, the values for **k** and **a** are set to represent an upper limit to peak particle velocities relative to scaled distance (shown as Upper Limit on Figure 4, which is based on over 10,000 measurements recorded worldwide). The following values for **k** and **a** were developed by the FHWA:

k = 100
a = -1.6

Thus, if a structure is 530 feet (1/10 of a mile) away from a blast and the peak particle velocity at that point is limited to 0.5 inches per second, then according to the formula above, the maximum weight of explosives that can be detonated during a single delay period, and still be under the limit to avoid off-site damage, is approximately 370 pounds (ODOT, 2005).

11. MITIGATION MEASURES

11.1 TRAFFIC NOISE

No noise level increases would exceed the 10 dBA impact criterion; therefore no noise mitigation measures are necessary. However, no information is currently available on truck traffic associated with the beneficiation plants. In the event that their volumes or hours of operation are sufficient to cause noise level impacts to local residents, the following discussion addresses the potential for mitigation.

Mitigation measures can focus on the source, the receiver, or the path from the source to the receiver. Noise barriers block the path from the source to the receiver. However, noise barriers are not a viable mitigation measure at the impact locations because the barriers must provide a long, unbroken wall to be effective. A quick way of estimating the required noise barrier length is to multiply the distance between the house and the travel lanes by 8, then assume that the noise barrier must extend out to a distance on either side of the home. Breaks in the noise barrier for driveway access or roadways would compromise its effectiveness. In addition, the roadway rights-of-way do not appear to be wide enough to permit construction of noise barriers without encroaching on residential property. Because the noise barriers must be high enough to block the line of site from source to receiver, they would have to be at least 10 feet high to reduce noise from truck engines and exhaust. To ensure that noise is reduced in second-floor bedrooms, they may have to be even higher. Therefore, noise barriers are not recommended as a mitigation measure.

Mitigation measures for the noise source include use of trucks with state-of-the art sound reduction packages and adherence to using properly maintained mufflers. Use of quiet pavements when resurfacing roadways may be helpful, although this technology is still in the experimental stage, and it would not reduce engine or brake noise.

Noise mitigation measures for the receivers could include provision of air conditioning so that residents have an alternate means of ventilation and can keep their windows closed during warm months.

11.2 WGC PLANT NOISE

A variety of reasonably available mitigation measures would be needed to reduce the noise levels at the site boundary and sensitive sites to 60 L_{dn} or less. Some were incorporated into the baseline modeling because they would be required in order to comply with OSHA workplace standards for employees. The forced draft and induced draft fans were modeled with silencers that can reduce the noise levels by 25 dBA or more. As stated previously, the cooling towers were modeled with splash attenuators and inlet silencers.

To achieve the 60 L_{dn} noise target at the site's property line, noise attenuation features would need to reduce the combined daytime noise levels of key noise contributors to below 53.6 dBA at these locations. Because multiple noise sources are being considered, contribution from individual noise sources should target a range of 20.0 to 40.0 dBA at the property line. Potential means of achieving this objective include methods such as:

- acoustic enclosures
- absorptive material on interior walls
- acoustic ducts and louvers
- noise curtains for conveyor motors, and
- more robust structural materials.

Placing acoustic walls around specific pieces of equipment, such as the conveyor motors, in order to increase the transmission loss, can also reduce noise. A similar approach is to place cladding around the steam turbine, which can be designed to allow visual inspection and maintenance of equipment. In addition, louvers and ducts in the walls of buildings permit more noise to pass through than solid steel walls. Acoustic louvers, packless silencers, and duct silencers can be installed to reduce the noise that is transmitted through these openings. Similarly, doors and windows can be designed to meet specific noise reduction criteria.

The available mitigation methods and strategies needed to reduce the noise levels from specific equipment to the desirable design criteria will depend on final design and selection of equipment. The specific suite of mitigation measures for the buildings and equipment, as supplied by the vendors, should be incorporated into the CADNA model to ensure that collective targeted noise levels will be achieved. After the CADNA model and mitigation measures have been fine-tuned for the final design, the WGC contract documents should specify that vendors and suppliers provide equipment that will meet the noise specifications. Operational procedures should include proper maintenance of equipment to prevent noise and vibration from equipment, such as conveyor belts, that may become noisy due to poor maintenance.

An example of the potential results from use of acoustic curtains around the conveyor motors for the worst-case site plan is shown in Table 11-1. The L_{dn}s are lower at all sites, and the nursing home location is now below the 60 L_{dn} criteria. Table 11-2 shows the top three contributors to noise levels at these sites.

Table 11-1.
Build Noise Levels at Plant Power Plant Sites with Acoustic Curtains for Conveyor Motors

Receptor Points		Modeled Results (dBA)			Build L_{dn}- 60 L_{dn}
Site ID	**Location**	**Daytime**	**Nighttime**	**L_{dn}**	
LT1	Plant - Southeast Side	56.8	66.8	63.2	3.2
LT2	Plant - East Side	Not applicable, property to be acquired			
LT3	Plant - North Side	64.7	74.7	71.1	11.1
LT4	Plant - West Side	53.9	63.9	60.3	0.3
LT5	Eco-Park*	54.3	64.3	60.7	0.7
LT6	Pennsylvania Avenue	55.1	65.1	61.6	1.6
C7	Retirement Community	57.9	67.9	64.3	4.3
C8	Nursing Home	52.9	62.9	59.3	-0.7
C9	ADA housing	55.1	65.1	61.5	1.5
C10	Mobile Home Park	54.2	64.2	60.6	0.6

Source: Potomac-Hudson Engineering, Inc., 10/7/05

Table 11-2.
Major Sources of Noise at Power Plant Sites with Acoustic Curtains for Conveyor Motors

Receptor Points			Highest Contributing Sources of Noise (dBA)		
Site ID	**Location**	**Daytime L_{dn}**	**1**	**2**	**3**
LT1	Plant - Southeast Side	63.2	49.5 DE aerator vent	48.4 STG east	48.0 STG east
LT2	Plant - East Side	Not applicable. Property to be acquired.			
LT3	Plant - North Side	71.1	58.2 ID fan	56.8 Coal mill east	56.8 Coal mill west
LT4	Plant - West Side	60.3	47.6 LP south	45.1 DE aerator vent	44.8 LP west
LT5	Eco-Park	60.7	48.0 LP east	45.6 CP south	44.5 LP south
LT6	Pennsylvania Avenue	61.6	5.0 DE aerator vent	49.3 ID fan	44.8 FD east
C7	Retirement Community	64.3	56.7 ID fan	46.2 FD east	41.3 CT inlet E
C8	Nursing Home	59.3	50.5 ID fan	42.5 FD east	40.2 STG east
C9	ADA housing	61.5	50.2 ID Fan	47.3 FD east	42.9 STG east
C10	Mobile Home Park	60.6	51.1 ID fan	43.4 Coal mill north	42.2 Coal prep north

Notes: FD = forced draft building east, west, or north wall
STG = steam generator building east, west, or south
LP = limestone preparation building east, west, or south
CP = coal preparation building east, west, or south
CT = cooling tower inlet
FM = finish mill east, west, or north wall
Source: Potomac-Hudson Engineering, Inc., 10/07/05

Some other sources of on-site exterior noise include the on-site truck and materials handling activities outdoors. In general, newer equipment is less noisy than older equipment due to better engine mufflers, refinements in fan design, and improved hydraulic systems. Therefore, the recommendation is that all vehicles and construction/yard equipment on-site represent the state-of-the art in terms of noise reduction. Other potential mitigation measures are as outlined below:

Conveyors and hoppers

- Proper maintenance to prevent squeaking and squealing of conveyors
- Retrofit chain conveyor with a urethane coating or urethane sleeve on the chain flights
- Use a urethane coating or urethane sleeve on the conveyor tail roller
- Line hoppers and bins with resilient material such as high-density polyurethane sheeting to reduce impact noise
- Where feasible, replace metal screens with rubber screens

Truck loading/unloading

- Maintain smooth surfaces to reduce tire noise and airborne vibration
- Maintain a 25 mph speed limit on-site to help minimize engine noise

Slamming tailgates

- Use rubber gaskets
- Decrease speed of closure
- Use bottom dump trucks
- Establish truck cleanout staging areas

Back-up alarms

- Replace alarms with strobe lights
- Replace alarms with rear-view back-up camera and/or back-up sensors
- Use lower sound levels late at night
- Use self-adjusting alarms that are 5 decibels louder than background noise levels (works best on smaller equipment such as backhoes and trucks and must be mounted as far to the rear of the machine as possible)
- Use an observer
- Configure traffic patterns to minimize backing movements
- Use manually adjustable alarms

Equipment use

- Restrict the use of pile drivers, jackhammers, and other very noisy equipment during nighttime hours
- Use local power grid to limit noise from generator use
- Use solar powered message/sign boards to limit noise from generator use
- Use smallest generators possible
- Where feasible, operate equipment at the lowest possible power levels
- Where feasible, use hydraulic powered or electric equipment instead of diesel-powered equipment
- Construct enclosures or use portable noise shields or acoustic curtains to reduce noise from specific activities

11.3 BLASTING

Recommended noise mitigation measures for blasting operations could include:

- No blasting on Sundays, legal holidays and between the hours of 8 pm and 8 am.
- Notifying nearby residences whenever blasting work will be occurring.
- Installing temporary or portable acoustic barriers around construction noise sources.

If blasting is planned, a pre-blast survey should be carried out to document the conditions prior to blasting. Coordination with local officials and residents should also be carried out to alert residents, including specifying the times of day when blasting activities would occur and a horn signal to alert the surrounding community of impending blasting activities. Any blasting activities would need to comply with the state guidelines such as the *Citizens Guide to Blasting* published by the WV Department of Environmental Protection in March 2002.

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